THE SAE JOURNAL

INDEX

JANUARY THROUGH DECEMBER 1965 - VOL. 73

Index of 1965 SAE Journal Articles

The Index of 1965 SAE Journal articles printed on these green pages is designed to make each moment you spend looking for information as productive as possible. The final objective is that you go back and read only articles that actually bear on your problem.

Here is the way to use the Index:

- Look up the subject heading of interest.
- Select all the titles under each subject heading that are of specific interest. Note the 6-digit number to the right of each title.
- In the Abstract Section, which follows the Index, look up the selected Abstracts by means of the 6-digit numbers. (Abstracts are in numerical order.)
- Look up all the articles that the comprehensive Abstracts show should have information of use to you. (Each article can be located by means of the code number to the left of the 6-digit number in the Index. For example, JL65-8-70 means: SAE Journal, 1965, August, article starts on p. 70.)

This Index thus gives you two stages of prescreening before you start pulling old issues. In a way it is like making changes in the design stage of a product, rather than during production.

At each step of the way the Index is tailored to help you find information rapidly and efficiently. First, the subject headings used are those agreed upon by 14 technical societies in an Engineers Joint Council project to simplify interdisciplinary terminology and indexing. As part of this approach, each article is indexed, on the average, under three to five headings.

In addition, you will note that your chances of finding the articles you need in this year's Index have been greatly increased because of the inclusion of cross-index headings. Most of these are more general terms, which are designed to lead you to more specific terms, which might cover articles of direct interest to you. Two types of cross-index headings are used:

- "See" is used to relate broad concepts – under which there are no entries – to more specific terms under which entries will be found. For example:

DESIGN
see
AIRCRAFT DESIGN
BUS DESIGN
CONSTRUCTION EQUIPMENT DESIGN
ENGINE DESIGN
PASSENGER CAR DESIGN
TRUCK DESIGN

- "See also" is used to relate broad concepts – under which are listed only very general papers on the subject – to the specific terms under which entries will be found. For example:

RELIABILITY
see also
AIRCRAFT RELIABILITY
MISSILE RELIABILITY
SPACECRAFT RELIABILITY

An expanded title is used for each article under the subject headings. This helps in your first stage of prescreening, since the expanded title is really a very short Abstract. If you are looking only for background information in a new field, chances are you won't have to go beyond this point to find the articles you want.

Note that the inclusion of an Abstract for each technical article printed in SAE Journal during 1965 is a depth service that allows careful selection without your ever having to leave the green pages.

An Author Index is also included in these green pages so that you can find what articles have been contributed by a particular author.

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650066 (JL65-1-65) **Reliability Tames Hydra-Headed Monster.** F. A. Thompson and W. D. Stein, Martin Co., Denver Div. In the early days of the Titan I program, reliability effort was confined primarily to product improvement activity. As tests uncovered hardware weaknesses, fixes were fashioned and put into the system.

The reliability lessons learned on Titan I served to organize the succeeding Titan II program better. A formal reliability program plan was included in the specifications, with reliability measurement and demonstration as part of the contractural requirement. The current Titan III program carries reliability operations even further beyond the normal engineering confines, expanding into all areas where any error can degrade the inherent reliability already designed into the product. This effectiveness-oriented expansion is aptly termed "practice reliability."

650067 (JL65-1-66) **Tin-Alloying Speeds Production of Gray-Iron Cylinder Blocks.** A. J. Tache and R. M. Cage, Chrysler Corp. Tin-alloyed gray iron is being used in the manufacture of automobile and industrial V-8 engine cylinder blocks by the American Foundry of the Chrysler Corp. The change-over to tin was accomplished without undue difficulty in the foundry. It has resulted in improved foundry and machine shop operation. The greater strength of the alloy, along with improved hardness characteristics and wear resistance, provide improved reliability and performance. Other advantages include a reduction in foundry cleaning operations, uniformity of hardness over varying section thicknesses, elimination of chilling and internal hard spots, and standardization on a single base iron for all of the foundry's products.

650068 (JL65-1-70) **Engines Like To Be Warm.** J. C. Brabetz and D. S. Pike, Chevrolet Motor Div., GMC. Many operators do not understand the reasons why the engine in their car or truck should operate at the correct temperature. It might come as a surprise to them to learn that the engine cooling system not only prevents the engine from overheating, but ensures maintaining the temperature at the ideal level.

650069 (JL65-1-74) **The Wing's The Thing.** R. R. Heppe and W. M. Magruder, Lockheed-California Co. By using a large, lightly-loaded, double-delta wing and a variable-geometry nose, Lockheed engineers feel they have taken a major step towards achieving a safe, economical supersonic transport configuration. Not only does the large wing provide high lift/drag values at cruise altitude, with corresponding fuel (and, therefore, gross weight) savings, it also makes for superior low-speed performance and helps reduce sonic boom and airport noise. Furthermore, the light wing load eliminates buffet as a problem. This is particularly important in the high-altitude, transonic acceleration flight region.

650070 (JL65-1-78) **Optimum Core Vital To Best Cooling System Design.** R. C. Schmidt, Cummins Eng. Co., Inc. Choice of the right radiator core is the first step in the design of a diesel-engine cooling system of adequate heat capacity and minimum fan horsepower requirements.

Radiator core selection is a compromise between styling, cost, space, and core characteristics.

650071 (JL65-1-80) **New Machine Improves Testing for Shaft Seal Reliability.** W. O. Heyn, Chicago Rawhide Mfg. Co. A machine for shaft seal testing has been developed which is more versatile and precisely controlled than any of its predecessors.

Built to meet specifications laid down by the Oil Seal Division of the Rubber Manufacturers Association, the test machine is capable of wider application than the barrel-type machine recommended in the SAE Handbook (J110a). For this reason it should eliminate the need for special application, company-designed machines which have introduced many

variables and have made the correlation of tests results between seal manufacturers or between manufacturer and consumer so difficult.

650072 (JL65-1-82) **Fuel Is Key To Diesel Smoking.** G. E. Irish and R. W. Mattson, Union Oil Co. of California. The constant loss of power and increasing smoke emission that plague diesel-engine users as mileage is built up has been traced to deposits on the injector nozzles. Recent tests show that fuel thermal instability is a major cause of injector deposits, and that hydrogen treatment of the fuels can slow this buildup radically.

650124 (JL65-2-32) **Small Cars Still Dominate European Market.** M. Platt, Engineering Consultant. More than half the total European market continues to consist of cars with a curb weight under 1900 lb. New cars, large and small, do, however, continue to be introduced. Some of the specific engineering design trends noted in the latest crop of European cars are discussed, particularly in regard to brakes, transmissions, heating and ventilation, and front-wheel drive cars.

650125 (JL65-2-44) **Cold Forging . . . Theory Is Catching Up With Practice.** R. Gaydos, Republic Steel Corp.; F. W. Boulger, Battelle Memorial Inst.; R. W. Gardner, Burgess Norton Mfg. Co.; and J. R. Pontius, National Machy. Co. Theoretical and experimental approaches to the problems of plastic deformation and its relation to cold forging are catching up with the practical state-of-the-art. Determination of required extrusion pressures for a specific application is one of the problems. So are punch and die shapes, length to diameter effects, material heterogeneity and homogeneity, strain-hardening effects on working pressures, residual stresses, and geometrical effects. Elevated temperature extrusion methods show promise of improving mechanical properties of cold-forged parts. Successful production of cold-forged parts requires careful choice and specification of materials to suit individual applications. Chemical analysis, foundry practices, and forging cycles are important factors in the selection of cold-forgeable steels for impact, direct, and indirect extruded parts.

650126 (JL65-2-55) **Catalytic Filtration Makes Fuel Fit For Fussy Supersonic Planes.** A. M. Leas, Ashland Oil & Refining Co. In-field catalytic filtration appears to be one effective way of supplying clean, dry, thermally stable fuel to supersonic aircraft and Mach 3 engines. With this process storage-degraded fuel can be converted into a fuel that meets high-quality specifications. Submicronic particulate matter, soluble chemical and biological contaminants, and moisture can all be removed in one simple operation.

650127 (JL65-2-56) **New Ebullition Cooling System Has Two Separate Circuits.** A. A. Tacchella and J. A. Fawcett, American Metal Bearing Co.; and A. N. Anderson. A recently designed dual-circuit ebullition cooling system for automotive engines consists of two entirely separate cooling circuits:

1. The engine circuit (a closed-cycle boiling and condensing circuit), in which the coolant is circulated by thermal action only through the engine, steam separator, and back to the engine.
2. The radiator circuit, in which the coolant is circulated by a pump through lubricating oil cooler, condenser, and radiator.

650128 (JL65-2-58) **A Transport Built For Two.** R. E. Bates, Douglas Aircraft Co., Inc. The key to the economic success of a short-range jet aircraft is the capability of operation by a two-man crew. This restriction requires simplicity in the cockpit which must have its origin in the most basic concepts of systems themselves.

Design characteristics which fulfill the objective of simplicity in the DC-9 can be placed in three categories:

1. Reduction or elimination of procedures for the flight crew.
2. Improvement in safety with special emphasis on adequate systems backup capability.
3. Reduction of maintenance requirements and improved troubleshooting capabilities.

650129 (JL65-2-62) **Simplicity Design Aim Of New Military Gas Turbine.** D. Quan, Hawker Siddeley Canada Ltd., Orenda Eng. Div. Orenda is developing a 600 hp 2-shaft gas turbine engine with stationary heat exchangers for military applications, such as army tanks. The engine is intended to achieve the low fuel consumption and low initial cost characteristic of diesels while maintaining the inherent advantages of the gas turbine's simplicity. Prime considerations in order of priority were: economy of fuel, reliability, low development and production costs and adaptability to production, compactness and light weight, ease of replacement of parts, interchangeability of parts between engines of the same model, low noise level at all frequency levels, and shock resistance.

650130 (JL65-2-67) **VTOL Auto-Control Gets Off The Ground.** L. J. Mueller, Honeywell, Inc., Aero. Div. Since the inception of VTOL design efforts, many systems have been proposed for solving the complex control problems. Of these, Honeywell has developed the only auto-control system that uses engine thrust modulation to obtain pitch and roll control.

Development of this system began at the behest of a German combine whose names recall earlier aircraft pioneering – Bölkow, Messerschmitt, Heinkel.

650131 (JL65-2-70) **Getting The Jump on Corrosion.** C. B. Ward, Air Force Materials Lab. Adequate corrosion preventive measures are *not* being provided at the time of manufacture, according to a recent USAF study of aircraft corrosion. Stress corrosion, exfoliation corrosion, and general corrosion were investigated, as well as ways to combat them. Extensive cost savings may be

realized by incorporating complete corrosion protection in the production phase of the aircraft rather than undergoing costly component replacement, repairs, and maintenance in service.

650132 (JL65-2-74) **Friction Welding – New "Natural" For Production.** M. B. Hollander, J. C. J. Cheng, and J. A. Quimby, American Mach. & Fdy. Co. Friction welding is classified as a forge or pressure welding process, and is often thought of as a competitor to flash butt and resistance pressure welding. However, friction welding has several features and advantages not found collectively in other welding processes. Among these are the ability to join an unusually large range and combination of materials, the high quality and consistency of the weld, the relatively simple and compact machinery needed for a given task, the economical use of power, and the minimal maintenance required by the friction welding equipment.

650400 (JL65-3-32) **Trends In Air Cargo: Factors That Will Influence Equipment Needs.** J. E. Gorham, Stanford Res. Inst.; J. Gilbert, Port of New York Authority; M. T. Hatae, North Amer. Aviation, Inc.; W. J. Hartigan, United States Post Office Dept.; E. P. Jaeger, Panalpina World Transport Ltd.; R. M. Sutton, Drake, Startzman, Sheahan, & Barclay; M. L. McKenna, Aerojet-General Corp., Atlantic Div.; R. B. Ulvestad, Planning Res. Corp.; B. H. Smith, Civil Aero. Bd.; K. R. Sealy, London School of Economics & Political Science; and A. H. Stratford, Hawker Siddeley Intl., Ltd. More attention should be paid to the overall picture in air cargo and less wasted on individual competition among air cargo carriers. The equipment, in the air and on the ground, should be designed to suit the needs of those customers and those routes that will generate overall industry growth, not just shortsighted rivalry among the carriers.

650401 (JL65-3-38) **Design To Eliminate Automotive Corrosion.** Corrosion prevention can be aided by thoughtful design practices that minimize exposure of metal surfaces to the corrosive action of water and road contaminants. Galvanic reaction between dissimilar metals must also be considered. In some applications both good design and protective coatings are necessary.

The designs illustrated were developed during the revision of SAE Information Report J447a "Prevention of Corrosion of Metals" by the Ferrous and Non-Ferrous Committees of the Materials Engineering Activity. The design is to eliminate any construction that would tend to collect dirt and/or moisture, and to minimize possible galvanic action corrosion of the metals.

650402 (JL65-3-42) **Technically Oriented Managers Face New Challenges.** J. A. Broadston, North Amer. Aviation, Inc., Rocketdyne Div. Technically oriented managers are having tested their ability to accept change and innovation not of their own doing; change that is thrust upon them by others. In many cases, they have been preoccupied with the technical. They have lacked full realization that – in managing multimillion-dollar enterprises – a sizable degree of concentration must be given to sound business economics and to improved management techniques. To meet these new conditions, technically oriented managers can get help from the behaviorist sciences to meet their "total" job of management. Today, quite a few industrial organizations – as well as a number of schools of business administration – have major residential training programs devoted to theory and practice in the behavioral sciences.

650403 (JL65-3-44) **Cold Forging . . . Machines, Tools, and Material Preparation.** J. R. Pontius, National Machy. Co.; R. W. Gardner, Burgess Norton Mfg. Co.; F. W. Boulger, Battelle Memorial Inst.; and R. Gaydos, Republic Steel Corp. The practical utilization of cold forging of metals has led to the development of specialized processes and machines for the preparation of materials to be formed. Automatic machines are capable of taking in raw materials and delivering finished parts. Cold heading is producing a wide variety of parts at high production rates, with good dimensional accuracy and surface finish. The proved economy of "chipless production" can be further augmented by close cooperation between the product designer and the tooling engineer. Experience and ingenuity in die design can lead to increased production, better part quality, and decreased manufacturing costs. The capabilities of multiple-station, automatic cold-forming machines are opening up many new and potential applications. U.S. manufacturers are applying impact extrusion methods primarily to the production of small symmetrical parts. But, the trend is toward larger cold-forged parts, with successful production ranging from less than an ounce to as much as 24 lb.

650404 (JL65-3-51) **Hard, Tough Alloys Yield to Electrochemical Machining.** G. K. Vandenburgh, Anocut Engrg. Co.; and L. J. Zimmel, Ex-Cell-O Corp. Electrochemical machining offers industry a tool for quickly removing metal from a 3-dimensional surface that does not lend itself to mathematical definition. Moreover, the rate of metal removal is independent of the hardness or toughness of the alloy being machined.

650405 (JL65-3-54) **It Takes Team Play To Crank A Cold Engine.** G. L. Cameron, C. W. Pettit, and G. A. Rowls, Delco-Remy Div., GMC. Battery, cables, cranking motor, and engine oil are the items that largely determine the cold cranking performance of internal-combustion engines. The individual and relative importance of each of these factors can be illustrated by a hypothetical example of a medium-sized, diesel engine charged with the crime of hard starting under cold conditions.

650406 (JL65-3-56) **Starve The**

Maintainability Wolf. J. M. Brearley, Bureau of Naval Weapons, Avionics Div. The spiraling complexity of modern avionics systems has left our experienced maintenance capability far behind, and the disparity is growing. This internal "maintainability gap" inevitably results in a disproportionately large amount of downtime. The growing significance of avionics as a prime target for improvement of maintenance capability is illustrated by the fact that avionics downtime increased 2½ times between 1959 and 1961, whereas downtime of all other aircraft functions remained approximately constant. Further, this problem of increasing complexity is compounded by an increasing loss of experienced maintenance technicians. The near future will find us needing approximately six times the number available.

650407 (JL65-3-58) **Three Ways To Tell When To Replace Trucks.** P. G. Anderson, Quality Bakers of America Cooperative, Inc.; W. J. Allen, Rohm & Haas Co.; and C. W. Boyce, Fleet Owner. Between the utterly simple practice of kicking a truck to see if it falls apart and the complex approach of hiring a genius and a computer, there are several commonsense ways to determine the appropriate time for vehicle replacement. These are the: frequency distribution method, discounted cash flow method, and obsolescence audit method.

All three require estimation and, therefore, are only as good as the basic data upon which the estimates are based.

650408 (JL65-3-60) **Thin-Film Circuitry Shrinks Size of Electronic Parts.** D. Hyndman, Lear Siegler, Inc., Astronics Div. Thin films of materials having the required electrical characteristics are being vacuum deposited on glass substrates to form reliable microcircuitry at low cost. By depositing the materials on selected areas of the substrate, resistors, capacitors, and conductors are formed. The substrate supports the deposited elements and provides contact areas for leads and structural strength for the circuit after fabrication and packaging. The circuit is completed by the addition of active elements – diodes and transistors – which are bonded onto contact areas of the glass substrate.

650409 (JL65-3-62) **Economic Aspects Of SST Design Become More Important.** F. W. Kolk, R. S. Stahr, American Airlines, Inc.; S. Flower, J. W. Flickinger, Pan Amer. World Airways, Inc.; F. S. Nowlan and K. W. Comstock, United Air Lines, Inc. Economic considerations intermingle more and more with technical decisions for SST, particularly in regard to choice of engine, operating routes, and cockpit layout.

650410 (JL65-3-68) **Rover 2000 Introduces Unique Body Construction.** H. R. Barber, Pressed Steel Co. Ltd. Unlike conventional construction, wherein body and frame are unitized, or separate, but in both instances the body contributing to structural strength, the Rover 2000 body is formed by applying skin panels to an operable, load-carrying framework. The appearance is that of a conventional car.

All skin panels are prepainted and interchangeable on any base unit or completed body. Moreover, there is no lead-loading for engineering purposes or quality standards.

650411 (JL65-3-72) **Mohats Shows Way to Haul Space Vehicles On Earth.** H. H. Thompson, FMC Corp., Ord. Div. To solve the problem of handling, transporting, and manipulating gigantic space exploration vehicles, a system has been conceived which employes modular running gear equipped with gigantic pneumatic tires. The basic 4-wheeled, modules can be coupled together in any number according to the requirements of various superstructures designed to pick up, carry, and manipulate payloads, which range in weight from 100,000 to 24,000,000 lb, and vary in size from 120 in. in diameter and 10 ft in length to 300 in. in diameter and 150 ft in length.

650412 (JL65-3-74) **Carbon Steel May Replace Alloy Steel for Certain Tank Gears.** B. Trock, Army Weapons Command. Induction-hardened carbon steel (1057) has been successfully tested as a replacement for carburized alloy steel in the final-drive pinion gears on the M-48 medium tank.

Although some spalling and pitting were noted, there were no failures in the four gears service tested for 2000 miles in tanks operating over various types of terrain.

The success of these gears appears to be due mainly to the short-time high-power-input heating cycle used, for gears of similar material but hardened with a long-time low-power-input cycle revealed tooth fractures resulting from overstress in tests which were run in other military vehicles.

650413 (JL65-3-76) **Truck Braking Improved Measurably Between 1955 and 1963.** S. C. Tignor, Bureau of Public Roads. Truck braking performance has improved measurably since 1955, regardless of vehicle type, weight, or capacity. Conclusions drawn from the 1963 Bureau of Public Roads study of braking performance of vehicles operating on public highways combine to support this statement.

The average distance for brake system application and braking has, since 1955, decreased by 2–3 ft for very light 2-axle vehicles. It has decreased as much as 10 ft, or more, for some of the heavier trailer combinations. Tests were conducted on a wide variety of commercial vehicles – ranging from 2-axle single-unit trucks to 3-axle truck-tractors with 3-axle semitrailers and 5-axle trailers.

650414 (JL65-3-79) **Air Force Turns Heat On Reliability.** A. T. Culbertson, Air Force Systems Command. The increasing complexity of electronic equipment, coupled with a rise in the failure rate, has created a headache for Air Force operational planners. This situation is respon-

sible for tying up millions of dollars in inventories, or a substantial portion of the Air Force budget.

650415 (JL65-3-80) **How Company Can Get Best From Technically Creative Men.** R. J. Schwinghamer, Marshall Space Flight Center, NASA. Successful managements are finding ways to stimulate creative individuals to make significant contributions in a way that enhances corporate profits and growth. They are achieving a viable balance in the six major areas of conflict that exist between scientific and management-type people. Resolution of these conflicts, inherent in natural and intellectual differences, is necessary to permit effective channeling of creativity to suit manufacturing needs. The basic differences can be described by comparing the scientific and the management outlook in the following areas: needs, goals, outlook, image, decision process, and identification.

650416 (JL65-3-82) **Tape Recorder And Computer Foretell Fatigue Failures.** W. E. Schilke, Allison Div., GMC. Power-train component duty cycle data is being collected, in the field, on analog tape recorders for subsequent digitizing and computer analyzing in the laboratory. The technique permits a given data recording to be analyzed in a number of ways to achieve different analytical objectives. Transmission output speeds and torque data collected are used to determine component fatigue life for reliability improvement programs. The permanently recorded data can also be used to analyze other factors such as engine operating conditions and fuel consumption.

650417 (JL65-3-88) **Nonash Dispersant Oil Use Might Become Universal.** B. W. Malone and B. M. Henderson, Shell Oil Wood River Res. Lab. The trend in engine lubricant developments is toward the compounding of low-ash or nonash multipurpose oils. Most of the nonash dispersant oils – now on the market for several years – are multigrade oils. They are well suited for today's typical long-drain, stop-and-go service. As new and improved nonash additives are developed, however, use of nonash dispersant oils could well become universal.

650538 (JL65-4-30) **Tomorrow's Automobiles – As They Look To F. Picard.** F. Picard, Regie Nationale des Usines Renault. The cars of tomorrow will reflect continued evolution in design. They will embody application of progress in techniques of energy production and transport.

A few of the many trends to be expected in the next 20 years are:

1. The 4-stroke carbureted piston engine is likely to maintain its supremacy for passenger cars.
2. The rotary engine, after having overcome some teething troubles, will take a much more important place than the turbine in competition with the piston engine for cars.
3. Turbine-powered cars probably will coexist with conventional cars, but not supplant them.
4. The Stirling engine is unlikely to find any kind of early application in passenger cars – because of its radiator, mechanism, weight, and regulation requirements.
5. Reaction propulsion, whether by propeller, turbojet, ramjet, or rocket, is unlikely for passenger cars.
6. Nuclear energy will be applicable to passenger cars only on conditio that new reactions of low critical mass and devoid of excessive parasitic radiation be discovered.

650539 (JL65-4-34) **Quantitative Measures Developing For Human Impact Tolerances.** L. M. Patrick, Wayne State Univ. Quantitative details about human tolerance to impact, translatable into car design, are emerging from research tests and studies. Injury potential is changing from a qualitative to a quantitative measure. Measurable parameters are being found with correlation to injury potential.

Many tolerance levels will be required to cover the different body areas and injury-producing devices. Many impact results are accruing from these studies.

650540 (JL65-4-36) **SST Fuels Ignite Economic Problems.** W. D. Sherwood, Trans World Airlines, Inc. Fuel requirements represent a major factor affecting supersonic transport economics. In addition to purchase cost, fuel properties such as thermal stability, burning quality, lubricity, and volatility can materially influence SST financial success. Proper airframe and engine design, however, can go a long way toward providing the best compromise of fuel technical and economic considerations.

650541 (JL65-4-38) **New Military Vehicle Designs Meet Special Army Requirements.** B. D. Sissom, Army Test & Evaluation Command; R. R. Gay, R. E. Zimmerman, L. G. Harshfield, and L. S. Moore, Army Tank Automotive Center; and T. J. Bischoff, Army Mobility Command. Four new vehicles stand out among those currently on their way to meeting special military requirements. Seven pilot models of a new 2½-ton 8 × 8 (eight wheels, all driven) cargo truck are beginning a year of test and evaluation. Also, a new 5-ton 8 × 8 cargo truck is on its way. A new concept in wheeled vehicle mobility is claimed for the XM561 (1¼-ton 6 × 6) cargo truck, which is now undergoing test and evaluation. Tests extending into 1965 have indicated a greater than anticipated range of capability for the two families of off-the-road GOER vehicles, each of which includes a cargo carrier, a fuel transporter and servicing vehicle, and a wrecker.

In addition, three new concepts for meeting the Army's heavy transporter requirements are being studied at the U.S. Army Tank-Automotive Center.

These, and all other military vehicles, have been or will be tested under the direction of the U.S. Army Test and Evaluation Command.

650542 (JL65-4-44) **Ten Ways To Relieve Tensions Common To**

Engineers. A. A. Klautsch, General Motors Inst. Ten ways are available to engineers to reduce the tensions spawned by worry, anxiety, and other forms of fear. Because his temperament and personality incline him to take pressures seriously, these tension-reducing processes are especially applicable to the engineer.

650543 (JL65-4-46) **Let's Cut Single-Car Accidents.** K. A. Stonex, General Motors Corp. The single-car accident contributes nearly 42% of highway traffic accident fatalities, or almost 16,000 deaths annually. Extensive research at the GM Proving Ground, including routine and special tests, highway redesign, crash investigations, and review of highway accident statistics, suggests the following deterrents:

- Remove impact obstacles (trees, walls, abutments, rocks, and railroad crossings, etc.)
- Provide cleared roadside areas to reduce "off-the-road" accidents.
- Eliminate two-way traffic to reduce multiple, single-car accidents.

650544 (JL65-4-54) **Scheduled Unit Overhauls Not Needed, UAL Programs Reveal.** P. A. Hussey and S. G. Thomas, United Air Lines, Inc. Overhauling airplane components at scheduled frequencies is hardly ever necessary. Only for specific cases to prevent specific modes of failure is scheduled overhaul required. Recent United Air Lines' studies show, in fact, that rigid adherence to arbitrary, often unrealistically-low time between overhauls usually will:

1. Actually tend to *increase* exposure to infant mortality.
2. *Not prevent* a complex or dynamic unit from failing at a low time since overhaul.
3. *Inhibit* or even prevent units capable of achieving high time between overhauls from realizing their full potential.
4. *Impede* exploration of high total time reliability characteristics of component parts.

Four special maintenance programs currently in use at United Air Lines support these conclusions – and illustrate a more rational and economical component maintenance program. These programs are organized explorations of the age-versus-reliability characteristics of components. They cover electronics, accessories, hydraulics, and air conditioning.

650545 (JL65-4-59) **Italians Fighting Back From 1964 Car Industry Downturn.** N. Morello, Fiat S.p.A. Purchase tax repeal in November 1964 may help the Italian automobile industry to turn depression tide. But economic, social and international instability still are of considerable concern to Italian producers.

650546 (JL65-4-60) **Digital Computers Assist Designer in Engine Development.** H. A. Cook, Thompson Ramo Wooldridge, Inc. The digital-computer-programmed engine is an effective tool for solving engine problems because of the complexity of engine parameters and their interactions with engine operation. Whether a particular problem is old or new, the use of the digital engine always seems to throw new light on it that helps the designer to decide the best direction to go in engine development. Some of the engine parameters that have been studied to advantage in the digital engine are: valve timing, ram effects, engine dimensions, and burning effects of different fuels.

650547 (JL65-4-65) **Car Deceleration Performance Changes Little From 1955 to 1963.** S. C. Tignor, Bureau of Public Roads. Little change occurred in passenger-car deceleration performance between 1955 and 1963 – when all cars are considered as a single group, Bureau of Public Roads tests indicate. But compact cars had significantly higher average decelerations at the 0.05 significance level than did the foreign cars involved in the 1963 BPR tests.

These tests also showed some decrease in the distance for brake application and braking since 1955, particularly above the 50 percentile level. Only the compact versus standard car comparison differed significantly at the 0.05 level.

The variability found in the distance for brake system application and braking has continued to decrease since 1955.

650548 (JL65-4-66) **Save On Helicopter Maintenance.** R. W. Caseria, United Aircraft Corp., Sikorsky Aircraft Div. A day will dawn when mathematical logic will replace emotion as the basis for setting overhaul periods for mechanical components of helicopters. Till then, helicopter maintenance costs will remain needlessly high. The trouble, so far, has been the widely held belief that mechanical items have increasing, rather than constant, failure rates. That is, the failure rate is usually thought to increase with age. This notion probably gained popularity from the logical link of mechanical items with wearout caused by fatigue and aging, and the way that bearings fail with an increasing rate. Probably more important than these reasons, the lack of progress may be caused by the scarcity of accurately reported field failure data and the high costs involved in carrying out extensive test programs.

650549 (JL65-4-68) **To Test King-Sized Products . . . Think Big!** L. A. Grotto, International Harvester Co. To test designs of component parts and entire vehicles of a new line of tractors and earth-moving equipment, International Harvester built and equipped a new test facility. Big enough to house the largest present or conceivable construction equipment, the test laboratory uses an "erector set" technique to eliminate costly special test fixtures. Test tools include the hydraulic dynamometer, pulsator, slow-cycle loading unit, accumulator, and connecting equipment used with jacks of various sizes. Parts tested range from less than one lb to 50 tons in weight.

650550 (JL65-4-72) **FRP Stalks Car Body Field.** R. S. Morrison,

Molded FiberGlass Co. The advantages of fiberglass reinforced plastics for body construction have been amply demonstrated, but a take-over from steel is still checked by economic factors and lack of public demand. Another FRP-bodied car is expected to make its bow within two years. Meanwhile, fiberglass panels will be used to face-lift some car bodies, and they will go into truck and trailer bodies in increasing volume.

650551 (JL65-4-74) **Chrome-Plated Steel Liners Extend Engine Life.** A. E. Maiden, Laystall Cromard Ltd. To get balanced engine life, particularly with diesel engines, the life of cylinder bores needs to be increased to match that of such components as crankshafts and bearings, which have been upgraded by using better materials and techniques. Chrome-plated cylinder liners will bring about the needed balance and give the operator many advantages.

650552 (JL65-5-32) **Take The Bias Out Of Tires?** A. Chiesa, Pirelli S.p.A.; V. E. Gough, F. B. Jones, and W. S. Udall, Dunlop Rubber Co. Ltd. Studies, here and abroad, show that radial-ply tires may offer longer tread life and greater cornering power than cross-biased tires. A softer and quieter ride, along with adequate handling characteristics, is still obtained with cross-biased construction. In any case, tuning the vehicle suspension to the type of tire being used is essential for optimum performance.

650553 (JL65-5-40) **Private Business Holds Key To World Economic Growth.** L. A. Townsend, Chrysler Corp. The universal hunger for national sovereignty and self-sufficiency is one of the few constants in our changing world. People everywhere are proud of their own flag and their own traditions – understandably so. They want nothing but the best and the most for their own countries. It is wisdom to recognize this . . . and to find ways to adjust to it and build on it.

650554 (JL65-5-42) **Titanium Alloy Is Best For Fail-Safe SST Pressure Cabin.** M. A. Melcon and F. M. Mueller, Lockheed-California Co. Recent data on candidate materials for the SST pressure cabin show that titanium 8-1-1 duplex annealed is the best choice for fail-safe design. Throughout the SST temperature environment, its fracture toughness is superior on a strength-to-weight basis to that of the best aluminum alloys at room temperature. And for comparable operating stress-to-weight ratios, its rate of crack growth at both room and elevated temperatures is slower than for the best aluminum alloys at room temperature.

Tests were made on flat panels, cylinders, and a full-scale titanium fuselage panel. They are important because the high cruising altitudes make sudden decompression less tolerable for the SST pressure cabins than for subsonic craft. . . . Therefore, fatigue cracks must be contained safely until they are detected and repaired.

650555 (JL65-5-48) **Turn to Diffusion Welding When All Else Fails.** W. A. Owczarski, United Aircraft Corp., Pratt & Whitney Aircraft. Diffusion welding is currently drawing wide attention for its ability to fashion highly complex assemblies using unusual alloy combinations. Because the process is basically a solid-phase welding technique – sometimes a transient liquid phase is utilized – all the advantages of low, uniform temperatures combine to produce high-quality results. Since the metal does not melt, as in fusion welding, cast structures are eliminated. And thanks to the absence of localized heating, the problems of distortion and residual stresses are also removed. Pressure is only needed to assure intimate contact between the joining surfaces. It need never be so great as to cause any significant deformation of the parts being diffusion welded.

650556 (JL65-5-51) **Engines Wear and Rust Less When Gasoline Contains No Chlorine Scavenger.** F. J. Cordera, H. J. Foster, B. M. Henderson, and R. L. Woodruff, Shell Oil Co. A measurable reduction in the wear and rusting of engines, particularly associated with low-temperature, severe stop-and-go service, can be obtained by omitting ethylene dichloride from the conventional Motor Mix lead scavenger combination used in gasoline. Such a change will also materially reduce the internal corrosion of mufflers and tailpipes. These benefits can be realized in normal passenger-car service, with no adverse effect on octane requirement, surface ignition or rumble, spark-plug fouling characteristics, or exhaust-valve durability, just as long as 0.3 theory of phosphorus is included with the ethylene dibromide in the mixture.

Because evidence exists that valve durability may be marginal in certain engines under heavy-duty operating conditions, further development studies are under way to find the optimum combination of scavengers to satisfy the requirements of this service.

650557 (JL65-5-56) **European Car Maker Is Up Against Low Purchasing Power.** H. R. Barber, Pressed Steel Co. Ltd. The main factors influencing what the European vehicle manufacturer will design and how he builds it are economic conditions, the state of the roads and traffic, the size of population, the national taste, and the number of manufacturers involved. The home markets are still the bread and butter ones, and what sells is what satisfies the purse and the way of life of the greatest number. It is no accident that the Chevrolet Impala and the Ford Galaxie are best sellers in America, while the Renault R4 and Citroen 2CV top the list in France. They reflect the pocket books of the domestic consumers, and the difference can be very great.

650558 (JL65-5-60) **Titanium – It's All In The Way You Work It.** G. J. Matey, North Amer. Aviation, Inc. When the workability of titan-

ium is compared with that of stainless steel and aluminum, there are outstanding differences, such as lower range, higher forces required, higher galling rate, resistant to sudden deformation, heat generally required to finish form, low shrinkability, harder material, and operations require more time.

With these characteristics of titanium recognized and techniques adapted to accommodate them, airframe parts are being successfully formed from sheet. As proof of this, 12,000 lb of titanium were used in the B-70 structure, and the SST (supersonic transport) will be practically all titanium.

650559 (JL65-5-63) **How Martin Company Controls A Single Research Project.** E. C. Soistman, Martin Co. Research can be controlled to a plan. And the research plan can be integrated into a company's overall division planning and control system. Martin Co. has maximized the return on its research dollars by just such a process.

650560 (JL65-5-66) **Electron Microscopy – New Tool for Service Failure Study.** W. R. Warke and J. L. McCall, Battelle Memorial Inst. Electron microscopy, now well established as a research tool for the study of metal fractures, can be valuable for analyzing service failures.

The high magnifications of electron microscopes, ranging from 500 to 200,000X, coupled with their large vertical resolution, make it possible to distinguish overload failures from fatigue failures from brittle intergranular failures, and so on. It is not possible as yet to make fine distinctions within any one category of fracture as to the stress, temperature, or other factors existing at the time of failure, but it may be possible to do so in the future.

650561 (JL65-5-68) **Truck Weight-Power Ratios Drop.** J. M. Wright and S. C. Tignor, Bureau of Public Roads. If a minimum requirement of, say, 400 lb gvw/net hp were imposed upon commercial vehicles, it would mean a minimum performance capability of maintaining 20 mph on a 3% grade and it would affect only a small percentage of the trucks now traveling on the highways. This conclusion is drawn from a braking performance study conducted by the Bureau of Public Roads in Maryland, Michigan, and California during which 1026 commercial vehicles, covering a wide variety of types, weights, and horsepowers, were sampled.

650562 (JL65-5-69) **Airborne Multiparameter Recorder Pinpoints Maintenance Needs.** B. M. Meador and J. F. Nemecek, Trans World Airlines, Inc. Multiparameter recording has the potential of playing a key role in the future of aircraft maintenance, recent evaluation of a modern airborne system indicates. The system's data generation, acquisition, retention, and diagnosis provide faster and more accurate knowledge than was previously available for many of the critical elements of in-flight performance.

650563 (JL65-5-71) **Diesel Engines Don't Have To Be So Noisy.** A. E. W. Austen, CAV Ltd.; and T. Priede, Southampton Univ. The predominant noise of automotive diesels that have adequately silenced exhaust and air inlet is produced by the rapid cylinder pressure rise resulting from combustion, unless mechanical engine noise is very high. The pressure rise induces transient vibrations in the engine structure and causes the outer surface to emit the noise. The two parameters can be controlled to reduce diesel noise:

1. Cylinder pressure level.
2. Attenuation of engine structure.

650564 (JL65-5-76) **Hydraulics Help Scraper Move The Earth.** J. A. Junck, Caterpillar Tractor Co. The Caterpillar 600 series tractor-scrapers make extensive use of hydraulically operated equipment. All operations formerly performed by cable are now performed by hydraulic components and systems.

By incorporating a hydraulic actuating system, it was possible to retain the desirable characteristics of previous cable scrapers and to add the inherent advantages of hydraulic equipment, such as:

1. Positive bowl down-pressure for better penetration of hard materials.
2. Positive apron down-pressure for closing of the apron during transit.
3. Independent three-lever control of bowl, apron, and ejector (a single cable formerly operated the apron and ejector).
4. Ease of operation and precise control.
5. Freedom from the equivalent of cable failure.
6. Simplicity to the man-machine relationships.
7. Safety of operation at high speeds.

650565 (JL65-5-80) **Now We Know How They Died.** D. F. Huelke and P. W. Gikas, Michigan Univ. Three important conclusions have been drawn from on-scene investigation of 104 fatal automobile accidents in which 136 people were killed. These are:

- The four principal causes of death were ejection, the steering assembly, door impact, and instrument panel.
- About 50% of the victims could have been saved with a seat belt-shoulder harness combination.
- Further reduction of fatalities requires redesign of car interiors to include crash attenuation features.

650603 (JL65-6-32) **Small Engines On The March Abroad.** W. E. Meyer, Pennsylvania State Univ. Development of the Wankel engine is being pushed hard in Europe in the expectation that it has a big future in the vehicle field. At the same time, both European and Japanese engine producers have come up with some interesting solutions to conventional problems. Fichtel & Sachs has placed in the field about 100 engines built under NSU-Wankel license, preparatory to going into commercial production. The Sachs KM37 delivers 6.5 hp at 5500 rpm and weighs 30 lb, or 4.5 lb/hp. It stands 10 in. high, exclusive of the muffler, which makes it one of the

lightest and smallest engines on the world market today. The model is aircooled and there is no oil circulation through the rotor, lubricated by a 1/50 admixture of oil to fuel.

650604 (JL65-6-35) **Automation Lifts Tractor Earth Blading Speeds.** E. T. Small, Engineering Consultant. Development of an automated cycle control system for earth blading has improved tractor dozer and bucket loader operation in three respects:

- Thickness of cut and spread can be controlled accurately.
- A smooth plane surface is bladed.
- Blading speed is limited only by the engine power of the tractor.

Proper blade readjustment during the blading cycle is the critical factor in producing a smooth bladed surface. The split-second timing and accuracy required have proved to be beyond human capacity with manual control except at very slow speeds, regardless of operator expertness. Basic to each blading cycle is a sequence of three reversing blade movements, each movement conforming to three exacting requirements. This applies both to the blade lowering cycle for increasing depth of cut, and to the raising cycle. The amount of vertical blade movement required is a mathematical proportion of the amount the blade is lowered, based on the relationship of the overhang to the distance between front and rear blade supports – whether the mounting is on a crawler, wheel tractor, or shoe supported combination.

650605 (JL65-6-38) **Plane-Crash Research Leads Way To Lower Life Loss.** J. W. Turnbow, Arizona State Univ.; J. L. Haley, Jr., Flight Safety Foundation, Inc.; S. R. Mohler, J. J. Swearingen, E. B. McFadden, and J. D. Garner, Federal Aviation Agency, Civil Aeromed. Res. Inst.; B. C. Doyle, Sr., and J. J. Carroll, Civil Aero. Bd., Engrg. Div. Fatality and injury rates in aircraft accidents can be decreased. If an accident is potentially survivable – in other words, if deceleration forces on the occupants do not exceed human limits, and the passenger cabin is sufficiently intact to provide living space – the following factors can determine survival:

1. Whether the seat and restraint systems sustain the impact loads or are torn away at impact . . . and how well the occupant's body is protected and prevented from flailing or hitting anything hard. Seats and restraints are inadequate at present; new strength requirements and some design improvements are recommended in this article.
2. How fast and completely evacuation takes place. Two minutes absolute evacuation time is now required by FAA for new jet transports. Improvements enabling a minimum escape time of 90 sec are recommended for future civil aircraft.
3. Suitability of equipment used for survival after evacuation, as in a water ditching. Improvements can well be made in this area, too.

650606 (JL65-6-45) **Better Education Chief Goal When Faculty Works In Industry.** N. A. Hall, Engineering Education Commission. For maximum value, familiarizing engineering educators with industry problems and processes should relate directly to the educator's work when he returns to the classroom. Too often, it doesn't. Too often it does not involve contact with introduction of new developments and new procedures – the heart of engineering in industry.

Involvement with this heart is needed to equip the educator to contribute new ideas to the educational program to which he will return. A current experiment in faculty internship in industry sponsored by the Ford Foundation is illustrative of such involvement. Through this program, a small number of carefully selected young faculty members are given a chance to work closely with key engineers in industry. They work on programs specifically designed to benefit their teaching responsibilities. Under careful administration positive returns for the faculty member are assured.

650607 (JL65-6-46) **Overseas Labor Uses Simple Tools To Build Light-Duty Truck.** K. P. Mazurek, E. D. Heins, and C. B. Hanssen, Chrysler Corp., Export-Import Div. Tooling for local production of cab and front-end sheet metal is a major element in the development of the Chrysler International XLV series of trucks (ranging from 4300 lb to 25,000 lb gvw) for low-volume production overseas by local labor. The parts can be made on simple tools – even though incorporation of tumblehome (roof narrower than the doors, with side glass slanted, as viewed from the front) after the first trucks were made, slightly complicated the design.

650608 (JL65-6-51) **Continuous Data Recording Tells More.** W. M. Borer, J. F. Hecht, Sr., and I. S. Jacobson, Lockheed Missiles & Space Co. Continuous data recording tells a lot more about the characteristics of a pressure-compensated pump than standard point-by-point test procedures can. For example, it has revealed suspected hysteresis in the pump compensator.

The pressure-compensated pump, which is usually electrically driven, is used in small missile hydraulic actuation systems without accumulators. The pump compensator is the single controlling element most directly involved in motor-pump pressure-flow and dynamic response characteristics. In the past, curves of pump delivery and motor current versus pressure were obtained point-by-point using conventional ammeters, pressure gauges, and flow meters.

650609 (JL65-6-52) **Tiny Turbine + Right Working Fluid = High Efficiency.** H. Z. Tabor and L. Bronicki, National Physical Lab. of Israel. The onus of poor efficiency, for which small turbines are notorious, can be lifted by a judicious choice of working fluid. If the working fluid has a high molecular weight, is chemically stable and noncorrosive, has a high boiling point, and has a saturated vapor line which nearly parallels the isentropic lines on a dia-

gram of properties, efficiency can be made almost independent of size. Even lacking the last characteristic, it is still possible to obtain good efficiency if the power cycle is properly "corrected."

650610 (JL65-6-55) **Check Before You Roll With Numerical Control.** R. A. Nellis, General Elec. Co. Analysis of your manufacturing cycle will indicate if increased productivity and profits can result from utilization of numerical control. Specific questions that will have to be answered include:

- Can manpower efficiency be raised by the assignment of simultaneous secondary operations?
- Will utilization of preset tooling increase machine productivity?
- What type of control is needed for the automatic machines?
- Are there adequate training programs for maintenance personnel?
- Are test instruments and spare parts sufficient to adequately support the maintenance program?

650611 (JL65-6-57) **Forming Trends to 1970 Point To Usual, Unusual Method Advances.** K. V. Hisey, Marquardt Corp. Many developments have emerged from laboratories recently to resolve problems of fabricating parts from some of the newer high-temperature, high-strength metals. Many of these relatively new forming processes will require extensive development, however, before justifying major capital outlays for new facilities and equipment. The present trend toward producing large sheet parts from high-strength metals, for example, will call for expanded development of elevated temperature processes. Conventional forming at ambient temperatures will experience a sharp decline. Forming by explosives and other high-energy methods will increase. High-pressure forming will make pressures of 20,000 to 30,000 psi commonplace in forming super-alloys and many other new metals.

650612 (JL65-6-58) **Improving Components To Pace Jet Transport Needs.** L. W. Vance, Vickers, Inc., Aerospace Div. A program of continuous refinement and improvement of parts throughout the life of an aircraft has been developed and applied by Vickers. How well it has worked can be indicated by citing results with hydraulic pumps:

- Reliability has been raised to the point where removal rates as low as 0.10/1000 hr can be guaranteed.
- Guaranteed maintenance costs/hour are now less than 10% of original cost/hour.
- Life has been increased to permit 4000–6000 hr between overhauls. An expedited program increased the time between overhauls on one model from 500–1000 hr to 2000–3000 hr in slightly over a year.
- Review has enabled proved components and design concepts to be used on second-generation jet transports to eliminate initial problems.
- In most cases, improvements cost the operator nothing. When costs were involved they were recoverable in one overhaul run.
- Part obsolescence due to improvement have been held to a minimum.

650613 (JL65-6-62) **Glass-Reinforced Tires Show Long Wear, Unusual Stability.** A. Marzocchi, Owens-Corning Fiberglas Corp.; and R. G. Henderson, Rhode Island Junior College. Glass cord reinforcement of automobile tires seems likely to produce advances in tire life and performance.

Test results to date indicate that glass cord reinforcement adapts more readily to radial structures, uses more effectively the advantages of radial tire design.

The conventional or bias ply tire, having since its inception used low modulus materials, represents a longer range development. The successful application of glass fibers to this design appears to offer tire properties approaching those of radial tires at conventional tire building costs. Four-ply bias tires have been built that will give 50,000 miles or more of tread wear on primary roads. The great dimensional stability of glass reinforcement will result in a more uniform tire, and in elimination of tire growth or flat spotting. Also indicated are quieter, smoother, more vibration-free tires.

650614 (JL65-6-64) **Boeing Nears Solution of Four Major SST Problems.** S. N. Weiner, Boeing Co., Airplane Div. Noise level, sonic boom overpressure, airport compatibility, and economics – problems plaguing the supersonic transport – are in varying degrees of solution on the Boeing 733.

650615 (JL65-6-67) **Three Ways To Form Sheet Metal With High Explosives.** L. Odor, North Amer. Aviation, Inc. When the facility and energy required to form the shapes and sizes of the space age metals is beyond existing capacities, or there is need to cut tool and labor costs, explosive forming could be the answer. Explosive forming is at best only another tool of production, but experience shows it to have great potentials, and if used judiciously it can be highly beneficial. Successful application hinges on many factors, the most important being size and placement of the explosive charge, and die design. The latter factor – die design – depends on whether the method is being applied to bulge forming, deep draw forming, or stretch forming.

650616 (JL65-6-74) **Ultrasonics Proves Its Worth In Detecting Fatigue Points In Roller Bearings.** I. Koved and R. T. Rospond, Hyatt Bearings Div., GMC. Ultrasonics has proved more effective than magnetic particle testing in locating potential fatigue nuclei in rolling contact bearings. It can, moreover, differentiate between poor, average, and good quality bearing steel in terms of group life performance. Experience has shown that the fatigue zone is located close to the bearing operating surfaces . . . and the ultrasonic technique proved itself better able to detect these subsurface discontinuities.

The long-sought goal of being able to obtain a degree of correlation between nondestructive tests and indi-

vidual bearing life has not yet been reached. Ultrasonic inspection has, however, already shown itself capable of differentiating, on a statistical or group basis, material quality in terms of life performance. With more sophisticated work and refinements in the method and equipment, the day may not be far off when bearings will be screened into groups with guaranteed performance characteristics.

The ultrasonic technique can also, foreseeably, be extended to inspection of raw material for bearings – an area of possibly greater economic significance. An ultrasonic criterion of material acceptability that accurately relates to life potential will be much better than current practices.

650617 (JL65-6-79) **Foreign Trucks Are Getting More Like Ours.** M. Kawada, Tokyo Univ.; M. Persia, G. Faraggiana, Fiat S.p.A.; and G. A. Kozloff, Chrysler Motors Ltd. More powerful diesel engines and an increase in load-carrying capacity point the direction of commercial vehicle development overseas. Broadly speaking, design trends move in the direction of American practice because worldwide highway development is bringing about conditions more like those in the U.S.A.

Regulation of commercial vehicles is in a state of flux, with weight and size limitations being raised slowly. Work on a uniform code for the European Economic Community proceeds and when put into effect will bring about more standardization in design. As goes the E.E.C., so goes England which, although not a Common Market member, must groom its vehicles with an eye to the great new market.

650618 (JL65-6-84) **Five-Continent Highway System Possible In Foreseeable Future.** C. A. Lindblom, International Harvester Co. Completion of a global highway transportation system requires a climate conducive to definition of common problems. No professional group is better equipped to help create such a socio-economic environment and to speed the project than the engineering profession.

Historically, the automotive industry, by demonstrating the efficiency of mass production, pushed United States industrialization and economic expansion very fast. Now, something similar is about to take place in many developing countries of the world. The impact of the population explosion and the advent of 20th-century transportation are accelerating worldwide economic and social progress. And today, development of better highways has become a concomitant to development of the vehicles using them.

650619 (JL65-6-85) **Nine Ways Army Is Emphasizing Better Upkeep and Reliability.** D. E. Breakefield, Army Supply & Maint. Command. Conditioning itself to live with less than desired resources, the U.S. Army is emphasizing ways to give its equipment reliability and maintainability. To this end it has introduced several changes and new concepts.

650620 (JL65-6-86) **Ford's New 240 I-6 Engine.** W. R. Smith, Ford Motor Co. Among considerations leading to the development of the Ford 240 cu in. engine, rather than to updating the established 223 cu in. engine, was the opportunity to design for displacement growth, lower manufacturing costs, and to include both power steering and air conditioning without increasing package length.

Some of the outstanding characteristics of this engine are: seven main bearings, separate intake and exhaust manifolds, hydraulic tappets, individual porting, individual rocker arm supports, cast rocker arms, provision for heavy-duty truck application, exceptional smoothness and silence, and reduced weight and compactness.

650621 (JL65-6-90) **Coated Columbium Alloys Can Take High Turbine Heat.** F. P. Talboom, A. D. Joseph, and E. F. Bradley, United Aircraft Corp., Pratt & Whitney Aircraft. D-43 niobium (columbium) alloy has the required strength, ductility, and weldability to make it suitable for turbine vane material. What it lacks is adequate oxidation resistance, but this can be imparted by the proper coating.

These facts were derived from evaluation of four alloys – FS-85 (Cb-27-Ta-12W-0.6Zr), Cb-752 (Cb-10W-2.5Zr), D-43 (Cb-10W-1Zr-0.1C), and a high-strength, solid-solution alloy designated Cb-132 (Cb-Ta-W-Mo) developed by the Battelle Memorial Institute. A hollow turbine vane was designed which required a 0.050-in. refractory sheet metal airfoil attached to refractory metal platforms.

650643 (JL65-7-30) **A Look To The Rear With An Eye To Safety.** P. L. Connolly and K. H. Marcus, Donnelly Mirrors, Inc.; and W. A. Devlin, Jr., Ford Motor Co. A satisfactory passenger-car rear-vision system has:

- Adequate field of view for all traffic situations.
- Mirror placement that gives optimum alerting ability and occupant safety.
- Freedom from vibration.
- Mirror reflectivity characteristics suitable for the full range of day and night light conditions.
- Auxiliary outside mirrors, when necessary, for an augmented field of view. These should possess the same basic characteristics as the standard interior mirrors.
- A new drafting room procedure permits pre-prototype evaluation of rear-vision system designs from the standpoints of placement and field of view in accordance with SAE Recommended Practice J834.

650644 (JL65-7-42) **Designing Tomorrow's SST Powerplant Today.** J. P. Little, Bristol Siddeley Engs. Ltd. Four Bristol Siddeley Olympus 593 engines will power the Concorde – the British-French Mach 2.2 transport. These engines – in design and early manufacturing stages – are medium compression ratio straight jets with aircooled turbines. The jet pipe and nozzle system is designed by the Societe Nationale d'Etude et de Construction de Moteurs

d'Aviation.

Among the problems the two companies face is the increased importance that nozzle, intake, and engine bleed design will assume for achieving good supersonic performance. They also cannot afford to neglect traditional component design, since subsonic flight conditions control almost half of the total fuel load.

650645 (JL65-7-49) **Company Gains, Too, When Engineer Works On SAE Technical Committees.** R. P. Trowbridge, General Motors Corp. An engineer benefits in many ways from participating in SAE technical committee activities. His company stands to profit, too – from having a better educated, better known, and more management-minded engineer on its staff. SAE technical committee work broadens the technical education of any engineer. It exposes him to and permits him to draw from the technical competence of every other committeeman with whom he associates. Helping to develop and bring into focus his committee's reports, he extends the frontiers of his knowledge of the technical fields involved.

650646 (JL65-7-50) **New Fastener Tests Strengthen Joint Reliability.** H. B. Sorensen, Buick Motor Div., GMC; J. E. LaBelle, Detroit Diesel Eng. Div., GMC; W. G. Waltermire, Lamson & Sessions Co.; and S. K. Clark, Michigan Univ. Nuts and bolts are providing improved joint reliability as a result of such new test equipment and techniques as:

- A machine that investigates torque-tension relationships.
- A bolt-load analyzer that measures preload, torque-tension loading, and other pertinent joint factors.
- A cyclic load tester that indicates the effect of repetitive loading on the loosening of nuts and bolts.
- A test fixture that adapts a conventional torque machine for determination of the torque-breakaway behavior of self-locking nuts.
- A technique that evaluates the effect of hardness on brittle-failure of bolts.

650647 (JL65-7-57) **Fabric Weaves Light Spacecraft.** J. T. Harris, Goodyear Aerospace Corp. Light-weight space vehicles are being fabricated from new high-temperature-resistant metal cloths. Packaged in a small space for launching, these spacecraft are expanded to shape after reaching orbit in space.

650648 (JL65-7-58) **A Super Transport Truck To Match A Super Highway System.** C. F. Maddox and J. G. McQuaid, Ford Motor Co. Ford has designed, built, and road tested a super transport truck consisting of a tractor powered by a 600-hp gas turbine engine, pulling two 40-ft tandem-axle trailers for a gcw of 170,000 lb.

The cab is elevated to the height of the trailer so that the airflow line is continuous from cab to trailer. Aerodynamic tests of scale models of the turbine truck and Ford's conventional HDT-950 truck tractor with similar trailers show the power required to overcome air resistance to be decreased from 203 to 119 hp by the new configuration. By the same token, fuel economy was increased 15%. Gains from fairing were inconsequential.

650649 (JL65-7-62) **Global Rocket Transport Offers Instant, Thrill-A-Minute Travel.** P. Bono, Douglas Aircraft Co., Inc. The possibility of rocket travel across the globe is being studied by Douglas. Their engineers have already outlined the basic features of a hypothetical rocket transport system called Pegasus (not to be confused with the Pegasus meteoroid detection satellite now touring the sky).

The staggering magnitude of such a project dictates that the proposed system be developed in two stages. First would come the basic booster, a single-stage vehicle capable of orbiting a payload comparable to that of the Apollo project's multistage Saturn V booster. After the kinks are worked out of the booster, a few alterations would enable it to lob men and materiel to any point on earth in less than an hour's time. To do this Pegasus does not need to have a 10,800-mile range (which is halfway around the world). Because there would probably be launch pads at both the Atlantic and Pacific missile ranges a 7500-mile range, which would involve about a 39-min trip, would be sufficient.

650650 (JL65-7-68) **Four Paths To Overseas Success for U.S. Automotive Companies.** L. A. Townsend, Chrysler Corp. A multilateral automotive company (one which manufactures and sells in many countries abroad) can thrive at the same time it helps the host country to prosper.

Establishment of good relations with the country in which plants are established will permit operation at full economic potential. Four approaches will help:

1. Make every reasonable adjustment to the host country's program for attaining its own economic aspirations. Respect its economic aims and work for their fulfillment.
2. Place local management as much as possible in the hands of local people. . . . When establishing a new operation, disturb existing personnel relationships as little as is possible.
3. Observe local customs – especially those which are hallowed by time. (The cornerstone of Chrysler's Turkey plant was sanctified with the blood of a snow-white ram in a highly successful ceremony.)
4. Adapt products and processes – especially engineering technical assistance – to the needs of the host country. Adapt realistically to the economic stage the country has reached. (In countries where labor is plentiful, for example, automation may not be the right first step on the road to progress.)

650651 (JL65-7-70) **Fixed-Wing Aircraft Could Handle VTOL Payloads.** E. R. Burn and D. R. Scarbrough, Lockheed-Georgia Co. If a fixed-wing airplane could place payloads in relatively inaccessible locations, it could fulfill missions now visualized for futuristic VTOL aircraft and be one up on helicopters,

which are relatively slow, short-ranged, and limited as to payload.

With this thought in mind, Lockheed-Georgia laid down seven objectives which any system would have to meet to be satisfactory, then computer-programmed six different systems. All but one – the trolley system – failed to meet one or more of the objectives.

650652 (JL65-7-72) **Analysis Pegs Reliability Early in Design.** W. F. Johnson, Jr., and R. H. Koester, Curtiss-Wright Corp., Curtiss Div. Justifiable approximations in logic and mathematics lead to development of satisfactory method of reliability analysis for use in early design studies.

650653 (JL65-7-76) **If Other Rubbers Won't, Maybe Propylene Oxide Will.** D. A. Meyer and E. E. Gruber, General Tire & Rubber Co. Exceptional low-temperature flexibility and ozone resistance are featured by Dynagen XP-139, a copolymer of propylene oxide and an unsaturated epoxide. These properties, coupled with good heat and flex fatigue resistance and moderate oil resistance, suggest that this PO rubber could serve well for such parts as motor and body mounts, windshield wiper blades, ball joint boots, suspension system parts, and various types of hose and tubing.

650654 (JL65-7-78) **SAAB Reveals Conclusions From 15 Years With 2-Stroke Engines In Passenger Cars.** R. Mellde, J. Eklund, and K. Knutsson, Svenska Aeroplan Aktiebolaget. The 3-cyl engines which have powered SAAB cars for two-thirds of the company's 15-year experience with 2-stroke units are of the Schnürle crankcase-scavenged type with piston-actuated induction parts.

An effective, simply arranged exhaust system gives this 3-cyl engine its superiority in maximum torque and fuel economy over the 2-cyl engine it replaced in 1956. The two performance elements are very dependent on a suitable pressure condition at and just outside the exhaust port with respect to the exhaust gas flow.

650735 (JL65-8-32) **Automotive Electrical Systems Sparked By Recent Advances.** A. J. Barra, Greer Technical Inst.; W. W. Vandercook, Boutell /F. J./ Driveaway Co., Inc.; D. A. Fay, United States Post Office Dept.; D. E. Hardacre, Commonwealth Edison Co.; F. P. Plovick, Delco-Remy Div., GMC; A. J. Thibodeau, R. L. Smith, and C. J. McLachlan, Ford Motor Co.; C. Shano, Motorola, Inc.; G. M. Galster, Champion Spark Plug Co.; J. M. Crawford, Tung-Sol Electric, Inc.; M. R. Lawyer, Holley Carburetor Co.; G. Putnam, McGraw-Hill, Inc., Fleet Owner; R. E. Valk, R. H. Publow, R. L. Simpkins, and R. B. Young, Essex Wire Corp.; R. W. MacKay and S. A. Florio, Eltra Corp., Prestolite Div.; J. E. Bald, Burlington Industries, Inc.; L. Zednick, R. Pribish, and H. G. Hughes, Chrysler Corp.; C. K. Morehouse, Globe-Union, Inc.; H. S. Davidson, Wolf /Abner A./ Inc.; R. K. Reese, Santa Fe Trail Transp. Co.; and R. C. Schmidt, Cummins Eng. Co., Inc. Significant advances in electrical systems are being forced by continuing progress in automotive vehicles and accessories. Improved performance and reliability are reported by manufacturers and users of batteries, starting systems, alternators, transistorized ignition systems, and wiring materials and devices. Facilities and personnel for servicing of the new equipment are growing rapidly.

650736 (JL65-8-43) **Reversed Scraper Rings Improve Oil Flow In 2-Stroke Engines.** W. D. Sims and S. S. Sorem, Shell Oil Co. Scraper piston rings, installed in 2-stroke-cycle gasoline engines in reverse of usual practice, so as to scrape oil from the crankcase toward the combustion chamber have produced: cleaner pistons, less spark-plug fouling, and fewer combustion-chamber deposits.

Such rings are capable of "pumping" oil against a considerable pressure gradient, which is what is needed to move oil splashed onto the lower cylinder walls toward the combustion chamber.

650737 (JL65-8-46) **Executive Turbojets Bring Changed Technical, User Problems.** R. J. Hixson, Ford Motor Co.; B. F. Prusek and K. W. Schoening, AiResearch Aviation Service Co.; and D. A. Baldwin, Texaco, Inc. Arrival of turbojets for executive transportation has brought new technical tasks to designers and new operating challenges to users. Surmounting these tasks and meeting these challenges has resulted in a valuable and highly modern aircraft.

Designers have about completed their transition to this new, more complex executive aircraft, which has required service operators also to update their technical capabilities. Executives are getting satisfactions from the new turbojets, for which many started pushing before their own aviation departments. And pilots, many of whom had to be retrained, are getting thrills and pleasures from business turbojet flying, even after it has become routine.

650738 (JL65-8-48) **New Long-Life Greases Make Possible Permanent Lubrication.** R. I. Potter, E. J. Schanilec and C. L. Knighton, Ford Motor Co.; W. L. Hayne, Jr., American Oil Co.; L. A. McReynolds and B. Mitacek, Phillips Petroleum Co. Several truly long-life greases, containing high-density polyethylene, lithium, and molybdenum disulfide, have proved so successful in recent tests that soon lubricating a vehicle after it leaves the factory will no longer be necessary.

650739 (JL65-8-51) **EDM Machines Its Own Niche In Industry.** E. W. Siegel, General Elec. Co. Electrodischarge machining is solving many metal-cutting problems – and doing it quickly and cheaply. Dies and other parts, ranging up to 30 in. and more in diameter, and containing 70–400 holes are being produced by EDM – often of materials that cannot be machined by usual methods.

650740 (JL65-8-56) **New Vauxhall Bus Features Smaller Tires – And More Of Them.** A. Williamson, Vauxhall Motors Ltd. Three schemes were evaluated and discarded by Vauxhall engineers before arriving at a twin-steering 6-wheel coach design which would meet preset static factors and their own dynamic convictions. The satisfactory scheme involves more tires of smaller size to give a more efficient load distribution pattern than large single tires. This article details the unsuccessful schemes, as well as the successful one.

650741 (JL65-8-60) **Much Current GSE Modifiable For SST Requirements.** A. H. D. Roeser, Boeing Co., Airplane Div.; and J. F. McDonald, Lockheed-California Co. Ground equipment proposed for use with supersonic transports has to be compatible with existing facilities. Also, of course, it will eventually have to be modified to conform with whatever aerodynamic and structural characteristics the supersonic transport turns out to have. From a ground maneuvering standpoint, for example, the supersonic plane must function on present, or near-future runways and taxiways. This dictates turning radii, which in turn predetermines landing gear location. All this creates the need for an extremely long towbar or a low-profile tractor.

650742 (JL65-8-62) **Sandwich Technique Brings Diffusion Bonding To Titanium.** J. E. Leach, Douglas Aircraft Co., Inc. Titanium structures are now being successfully diffusion bonded with the aid of hot plate rolling mill reduction techniques. The problem, heretofore, has been that titanium and certain other metals useful to aerospace designers oxidize readily at bonding temperatures. In the new "roll-welding process," as it is called, these materials are hot rolled in a protective jacket of mild steel, which is later removed from the materials. The hot rolling operation provides the necessary pressure, temperature, and time to interdiffuse the metals, producing diffusion bonds equal in strength to the base metal. This allows large truss core sandwich panels and other structures requiring high strength to be produced successfully.

650743 (JL65-8-66) **Gasifier Can Drive Free Turbine Accessories.** C. A. Amann, General Motors Res. Labs. When a fixed-geometry, free turbine engine drives some accessories through its gasifier shaft, the turbine inlet temperature tends to rise, particularly at low gasifier speeds. Since the temperature allowed at this point is limited, higher steady-state values will reduce the excess power available for accelerating the gasifier. If good engine performance is to be retained, the factors affecting turbine inlet temperature must be understood. Appropriate steps can then be taken to avoid high temperature troubles due to the power demands of gasifier-driven accessories.

650744 (JL65-8-68) **Steel User-Maker Understanding Bettered Via Div. 32 Successes.** A satisfactory standard mechanical means of measuring surface finish is the latest achievement in 11 years of fruitful accomplishment by Division 32 of the SAE Iron & Steel Technical Committee. Now established as an SAE Recommended Practice, this newly agreed-upon method of measuring sheet steel surface texture involved, in its later stages, a round robin test to evaluate a recommended test procedure. But the possibility of achieving a standardized means – suitable to both steel producers and users – became a probability some months ago when it was agreed that all Division 32 users prefer practically the same smoothness of surface finish. This resolved a major problem for steel producers.

650745 (JL65-8-70) **Positive Expulsion Devices Assure Smooth, Reliable Starts For Spacecraft In Zero-G Space.** R. N. Porter and H. B. Stanford, Jet Propulsion Lab., Calif. Inst. of Technology. Positive expulsion devices for unmanned spacecraft, already successfully used on the Ranger and Mariner series, are now being developed by JPL to meet more stringent requirements. New concepts, materials, and testing procedures are needed to obtain long-term storage of oxidizers, high inherent reliability, multiple start in free fall, and engine throttling.

650746 (JL65-8-78) **Civilizing The 4-Wheel Drive.** R. H. Freeburger, Army Mobility Command; P. B. Hartman, Kaiser Jeep Corp.; and O. E. Phelps Dana Corp., Salisbury Div. Simpler controls and a more comfortable ride are being sought by designers of both military and civilian 4-wheel drive vehicles. In addition, the military want better off-highway mobility, higher ground clearance, better flotation, and improved ground contact of driving wheels, while keeping silhouette low. Designers of civilian vehicles, on the other hand, seek to lower the silhouette to produce a more orthodox appearance and ultimately to incorporate devices for the delivery of power to the wheels without any intermediate gears and shafts being needed.

650747 (JL65-8-81) **Electrocoating Reaches Those Inaccessible Surfaces.** H. N. Bogart, G. L. Burnside, and G. E. F. Brewer, Ford Motor Co. Electrocoating, the deposition of an electrically charged colloidal paint, using an electric current, is the most effective and least expensive method of painting automotive components and assemblies yet devised.

As a primer system, electrocoating approaches the ideal. It makes possible the application of corrosion-resistant, tough, smooth, and durable film on those inaccessible surfaces that are being exposed to increasingly severe conditions. It applies this film uniformly, so that the film is free from such defects as wedge, sags and runs, fat edges, unpainted edges, and tears. And it applies the film automatically, with high paint efficiency and without hazard.

650748 (JL65-8-84) **Longer Haul Between Overhauls New Jet Maintenance Strategy.** J. W. Stillwell,

Douglas Aircraft Co., Inc., Aircraft Div. Emerging trends in jet transport aircraft maintenance indicate:

1. Reduced reliance on scheduled component overhaul as a "preventive" maintenance technique.
2. Increased emphasis on system and subsystem integrity and decreased preoccupation with the condition of individual components.
3. Increased awareness on the part of aircraft manufacturers that maintainability must be designed into their products and that self-test and self-check features are desirable in most functional systems. These new trends in aircraft maintenance are expected to result in improved jet transport safety and reliability at reduced cost.

650749 (JL65-8-86) **Oxide Tools Can Give Significant Gains Now.** R. G. Brierley, General Elec. Co. The superior hardness of cemented oxide cutting tool material – both at room and elevated temperatures – makes it particularly well suited for increasing production rates – through higher cutting speeds, longer tool life, and fewer tool changes. The chief limitation of this material is its low transverse rupture strength – about one-half that of the hardest cemented tungsten carbide. Another important characteristic is its chemical inertness, which is both an advantage and a disadvantage. A better finish is often produced, but the material cannot be brazed.

650750 (JL65-8-88) **Tracked Hovercar For 300-MPH Intercity Travel.** A. F. A. Hassall, British Technical Service Corp. Land versions of the hovercraft, running on prepared tracks for rapid intercity transport, are likely to enter the prototype stage in the next few years.

Encouraged by test performance of hovercraft in heavy seas and the probability that these air-cushioned vehicles will be used in commercial ferry service, first across the Solent and later in cross-channel service to France, British manufacturers see application of hovercraft principles to land vehicles as the next logical step. The vehicle might operate on an inverted shallow V-track. Propulsion would be by linear electric motor or pusher air propellers.

650751 (JL65-8-90) **Experimental Car Suggests Possible Uses of Copper Alloys.** H. W. Pender, Chase Brass & Copper Co.; and V. M. Exner, Exner /Virgil M./ Inc. The Mercer-Cobra experimental sports car was developed under copper industry sponsorship. Its design includes maximum use of copper alloys in both decorative and functional applications. Most of the exterior trim, for example, is made of 0.040- or 0.050-in. thick No. 655 silicon bronze alloy having a light brown-gold color. This material is one of 11 standard color-keyed copper alloys now available.

650870 (JL65-9-50) **Tomorrow's Automotive Glass – A Dynamic Element In Car Design.** R. G. Whittemore, Pittsburgh Plate Glass Co.; J. C. Widman, Ford Motor Co.; and J. D. Ryan, Libbey-Owens-Ford Glass Co. Among the coming advances in glass that are applicable to automobiles is windshield glass made more flexible and penetration-resistant through the use of a thicker interlayer bonded more loosely to the glass. But there are other interesting glass products being developed that should also be applicable, such as:

- Phototropic glass of considerably improved properties.
- Electrically heated glass – which may prove suitable for use in rear windows, and even in windshields.
- Thinner, lighter, and more flexible tempered glass – which might be used for side as well as rear windows.

650871 (JL65-9-53) **Airline Landing Accidents Trending Downward.** V. A. Taylor, Flight Safety Foundation, Inc. Air transport approach and landing accidents appear to be occurring less frequently and causing fewer fatalities. A recent study (1959–1962) compared with an earlier accident report (1946–1958) indicates that this favorable trend is due in part to the introduction of jet transports. Within the approach and landing category, however, accidents due to undershoot, inaccurately assumed position, and landing gear failure seem to be on the increase.

650872 (JL65-9-56) **Radically New Joining Methods Simplify and Improve Packaging Of Microelectronic Circuits.** W. S. Rigling, Martin Co.; L. Marks, E. C. Cormier, and N. Tarowsky, General Dynamics/Astronautics; H. G. Manfield, and A. Letchford, British Ministry of Aviation; J. W. Slemmons and J. R. Howell, North Amer. Aviation/ Autonetics. Recent radical advances in microelectronic circuits – especially the integrated and thin-film forms – are bringing equally radical advances in the methods used to join these microcircuits into more useful electronic systems.

650873 (JL65-9-64) **Regeneration Aids Fuel Economy Of Aircraft Turbine Engine.** H. B. Crockett, and R. E. Field, Lockheed-California Co.; G. E. Chapman, W. A. Redmond, and P. E. Beam, Jr., Allison Div., GMC. Fuel economy, exceptional endurance and range capabilities, and decreased take-off gross weight and distance are improvements in aircraft performance offered by the application of regeneration to the turboprop engine through exhaust heat recovery. Evolving from the development of advanced lightweight heat exchangers, the following three basic types of regenerators show promise of providing these benefits for the long-range, long-endurance aircraft on patrol or search missions:

- Liquid-metal-coupled.
- Rotary (rotating matrix).
- Direct gas-to-air.

650874 (JL65-9-68) **Plastic Strain Accumulation – New Fatigue Life Forecaster?** S. W. McClaren and J. H. Best, LTV Aerospace Corp., Vought Aeronautics Div. Examination of the low-cycle fatigue performance of several aerospace materials indicates that fatigue life predictions based on plastic strain accumulation

may be more accurate in some cases than predictions based on Miner's theory. The accumulated strain concept considers uniaxial and biaxial stresses, and notch toughness in determining the fatigue life of materials subject to high stresses for relatively short cycling periods.

650875 (JL65-9-76) **The SST Has An Inside Problem.** N. D. Folling, Pan Amer. World Airways, Inc. Greater emphasis must be paid to the interior arrangement of the SST if the full payload-range-economics is to be gained.

Airline thinking on interior arrangement tends to be based on immediate problems to the exclusion, or relegation to second place, of total capability requirements. This thwarts reaching the basic objective, which is to carry maximum payload at supersonic speeds for at least 4000 miles at minimum cost.

An inefficient aircraft from a payload arrangement and capability standpoint is easy to recognize but the total effect on economics is hard to assess. Commonly an attempt is made to assign a dollar value to the unrealized payload capability, but it doesn't work too well. A more practical approach would be to estimate the magnitude of the penalty for inefficient use of the space in terms of payload-range-economics during the preliminary design phase.

650876 (JL65-9-79) **Getting Better Ventilation Through Body Design.** K. Wilfert and H. Goetz, Daimler-Benz AG. Determining the required ventilation equipment for a given body design requires knowledge of static pressure conditions at the pertinent spots.

Of the air inlet systems dependent on dynamic pressure or independent of dynamic pressure (fans), the first requires a high positive pressure (ram) zone. Outlet systems, on the other hand, must be located in negative pressure regions. To meet these demands may require changes in shape.

The modern car has three positive pressure zones: a high one at the front, a medium one in front of the windshield, and a low one at the rear. There are also two negative pressure zones – a medium one on the front portion of the hood and a high one on the front portion of the roof, which drops steadily toward the rear. The sides are enveloped in a medium negative pressure zone decreasing toward the car rear.

650877 (JL65-9-83) **Taking The Squeal Out Of Brakes.** J. E. Gieck, World Bestos Co. The type of noise that comes and goes erratically with both disc and drum brakes is due primarily to circumferential vibration of friction material and supporting stationary components of a brake assembly. Ultra slow-motion photomacrographic studies indicate that noise frequency is a function of the torsional mass of the friction element support system (caliper, shoe and backing plate assembly), and the stiffness of the components supporting this mass.

650878 (JL65-9-84) **Business Aviation Departments Too Often Fly Blind.** H. D. Kysor, Aeronautical Consultants & Associates, Inc. There is a great gulf between the manager of a business aviation department and top management. Reason? Few business men know enough about flying to make intelligent corporate policy decisions for their aviation department. Few pilots are sufficiently grounded in modern business management to run the department like any other service department of the company.

This gulf prevents a company from getting the full benefit from business flying; worse, it can bring about the disposal of an aircraft fleet. Bridging this gulf is necessary before quality control can be put to work and this, basically, is the job of the business aviation consultant who brings to the problem knowledge of piloting and management plus perspective.

650879 (JL65-9-86) **Programmable Tire Testing Machine Offers Realism and Versatility.** S. A. Lippmann, United States Rubber Tire Co. A sophisticated test device for determining the action of various tire parameters offers exceptional investigative versatility. This new testing machine can apply programmed dynamic loads to a wide range of tire sizes at realistic rates. Force components and torque responses can be measured and recorded. Tire behavior under steady-state conditions also can be simulated and studied with this advanced equipment.

650880 (JL65-9-90) **Fluid Technology . . . A State-Of-The-Art Report.** R. A. Evans, Honeywell, Inc., Aero. Div. Fluid technology, the technique of using the flow of fluids to accomplish sensing, computation, or actuation without the aid of electronics or moving mechanical parts, has advanced greatly since its initiation in 1958. Significant problem areas still exist, however, and much research and development remain to be done.

650881 (JL65-10-30) **Potential Of Powder Metallurgy Is Tied To New Strength And Versatility.** R. Talmage, Powder Metallurgy Consultant. Advances in powder metallurgy technology are producing sintered materials whose mechanical properties approach or exceed those of more conventional metals. Improved manufacturing techniques are permitting wider design latitude and reducing production costs. New applications of the versatile material are appearing in current production cars – many more are in experimental stages. One drawback today is the comparatively high cost of the basic metal powder in low-volume production.

650882 (JL65-10-34) **Fast Field Weighing Of Earthmover Loads.** R. C. Gessel, LeTourneau-Westinghouse Co. A portable scale capable of weighing earthmoving equipment with a 250,000-lb axle load in 1–1½ min, with 1/10 of 1% accuracy has been developed, built, and tested by LeTourneau-Westinghouse. The new scale overcomes the drawbacks asso-

ciated with such weighing devices as hydraulic jacks, hydraulic single-wheel platforms, and electric single-wheel scales. Hydraulic jacks and hydraulic single-wheel platforms can be accurate if properly used, but they are difficult to handle and time consuming. The electric single-wheel scale gives dubious results and it, too, takes too long to operate.

650883 (JL65-10-36) **Supersonic Cruise Craft Cooling Is Complex.** L. L. Christensen and J. A. Richards, North Amer. Aviation, Inc. Supersonically cruising airplanes will need larger, more complex, environmental control systems for cooling than subsonic craft because of their prolonged exposure to high temperatures. Air taken aboard at Mach 3 will be 630 F. Engine duct inner surfaces will be only slightly lower. Skin temperatures will be about 450 F for most of the exterior surface. Despite the needed large capacity, weight and drag of the environmental control systems must be minimized. Of the three most likely candidate systems, the air-cycle refrigeration machine will probably be used to cool the first generation of supersonic transports . . . mostly because of its excellent service history. However, two major problems accompany its use – ensuring an adequate air pressure supply and an adequate, low-penalty heat sink. Because available solutions to these problems are complex and introduce more weight, two other systems – precooled fuel used as a direct heat sink, and vapor-cycle machines – are under consideration. With large quantities of refrigeration a must, a dependable heat sink is essential. The two most available heat sink media for continuous heat disposal are air and fuel. Ram air (at a temperature of 630 F) can provide only a part of the requirement. Fuel will be used extensively as a heat sink – but heat sink conservation practices will still be needed.

650884 (JL65-10-41) **Radial Load Measuring Device Proves Validity Of LOP Seal Tests.** W. W. Rasmussen and R. V. Brink, Victor Mfg. & Gasket Co. A new device for precise measurement of radial loads imposed on shafts by oil seals proves the validity of the lip-opening-pressure concept for quality control of mass-produced shaft oil seals. A mathematical determination of seal-imposed radial loads, used to determine lip-opening-pressure values, is verified by the measuring device. Investigation, however, indicates areas of possible inaccuracies using the lip-opening-pressure technique, and shows that lip-opening-pressure is not sufficiently sensitive for reliable evaluation of seals for large (over 4-in. diameter) shafts.

650885 (JL65-10-44) **Better Breathing And Burning Boost Small Engine Power.** Y. Nakamura, Honda Res. & Dev. Co., Ltd. Getting more power out of small, high-speed engines . . . that's one assignment of the Honda Research & Development Co. in Japan. They're attacking the problem on three fronts – by increasing volumetric efficiency, speeding combustion-flame propagation, and minimizing power-consuming mechanical power losses.

650886 (JL65-10-48) **Three Steps To Ideal Transistorized Ignition.** J. W. Sharpe, Lucas /Joseph/ Electrical, Ltd. Three solid-state ignition systems have been developed by Lucas of England to meet the needs of modern high-speed engines. These are:

- A simple transistor-assisted contact system, which has been on the market for some time. It is not fully transistorized, for breaker and contacts are still used.
- A more highly transistorized system with no rubbing contacts. It was developed specially for racing engines.
- A highly transistorized oscillating pickup system that can operate satisfactorily at both low and high speeds. This general-purpose system is still under development.

650887 (JL65-10-52) **Moving Gigantic Rocket Engines Takes Even Bigger Transporters.** B. M. Teague, Martin-Marietta Corp., Aerospace Div. Transporting and handling the large solid rocket engines of the future may be done by: pneumatic tire transporter, crawler transporter, and Hovair (air cushion) transporter. All three types of transporters will be capable of handling rocket engines expected to weigh 5,000,000–6,000,000 lb with diameters in the range of 260–360 in. Of the three, the Hovair transporter appears to be the most economical.

650888 (JL65-10-55) **Air Cushion Vehicle Needs Lift From Engineers.** J. B. Chaplin and W. J. Eggington, Bell Aerosystems Co. Whether the air cushion vehicle comes to play a minor role in passenger transportation similar to the hydrofoil and the helicopter, or a major one comparable to the ship and the airplane depends on what engineers achieve in the next few years. The challenge to the engineer is to reduce direct operating costs through improvements in power requirement and durability. The only other area where there is promise of significant improvement is in simplifying design, mainly in reducing the number of parts, standardizing them, and simplifying attachments.

650889 (JL65-10-56) **Retarders Can Speed Wear Of Powertrain Gears And Bearings.** R. K. Super and W. A. Johnson, Rockwell-Standard Corp.; W. Trisler and D. W. Holzinger, Dana Corp.; and H. R. Baumgardner, Firestone Tire & Rubber Co. Retarders, applied to conventional powertrains on heavy trucks and buses, have both beneficial and detrimental effects on component wear. Experience shows that:

- Engine, clutch, transmission, and propeller shaft assembly torque effects are not influenced.
- Engine operating temperature remains more constant during downhill running, thus avoiding cylinder wall and piston damage.
- Drive-wheel bearing, drive-unit bearing, and drive-gear wear increases significantly.
- Tire tread wear is increased on retarder-controlled wheels, decreased on

nondriven wheels.

• Brake heat buildup is decreased.

650890 (JL65-10-59) **Manufacturing: Top Opportunity For Top Engineering Graduates.** R. G. Folsom and K. E. Bisshopp, Rensselaer Polytechnic Inst.; M. G. Fox, Evanston Ill. Township High School; W. W. Gilbert, General Elec. Co.; C. L. Tutt, Jr., General Motors Inst.; and K. C. White, TRW, Inc. Manufacturing has "opportunity unlimited" for top engineering graduates, and educators can benefit students and industry by emphasizing its potentials. But manufacturing requires graduates who are tops in something besides the technical knowledge high marks reflect. Needed also is ability to cope with human problems. "The lower half of the graduating class after 20 years usually is hiring the top half," one educator notes, "because ability to handle people is a prime requisite for success in industry. The ability to cope with human problems, so necessary to the manufacturing engineer, is characteristic of more who graduate in the lower half than of those who are tops in school."

650891 (JL65-10-60) **How To Prevent Crazing Of Anodized Aluminum.** C. E. Michelson, Olin Mathieson Chemical Corp. Important factors affecting crazing of anodic coatings are the temperature to which the aluminum is heated, the period of heating, and the properties of the anodic coating. Higher than normal temperatures are more influential in promoting crazing than too long a time of heating. The primary coating properties that determine the extent of crazing are the coating thickness and the time of sealing. Stressing the coating by bending the part also influences the crazing pattern. The important consideration is the actual metal temperature, which is determined by the temperature of the oven, the air circulation, the mass and configuration of the part, the surface emittance, and the time in the heating zone.

650892 (JL65-10-64) **Cars In The Future – An Engineer Dreams Ahead.** H. E. Chesebrough, Chrysler Corp. Let's give imagination free rein and look at a possible system that might help to meet personal transportation needs sometime in the future. First, imagine a vehicle carrying four people and operating under driver control on ordinary streets as we know them today. Imagine that this completely enclosed vehicle has controlled atmosphere within its interior. Its motive power might be an energy-converting device, possibly electric drive. The energy source could be storage batteries, fuel cells, or other electricity-generating device. Designed into the vehicle's front end is a socket, which receives a contact prong to permit battery recharge while the vehicle is at rest. This contact is engaged by running the vehicle into the prong. (This operation is compatible with the evident preference most people have to park their vehicles by running into some barrier – such as the other fellow's bumper.) This vehicle contains all desired accessories and appointments. It has padded this and padded that – and some equipment not yet envisioned. It could be operated as we operate today on today's streets and roadways. But to take advantage of one other facet of the system, it will have to match (approximately) all other then-operating vehicles as to width, height, protuberances, and ground clearance – and also be equipped with some form of control system.

650893 (JL65-10-66) **Rocket Engines Space-Tested At Sea Level.** R. E. Smith, Jr. and J. Ferrell, Jr., ARO, Inc.; G. D. Westcot and J. E. Hausman, Aerojet-General Corp.; D. D. Hofferth, E. L. Wilson, and A. L. Polansky, Douglas Aircraft Co., Inc. The most important condition that a high-altitude cell for testing rocket engines on the ground must simulate is a low-pressure environment. The range of pressure altitude depends on the test objective. (Pressure altitude is the altitude in the standard atmosphere corresponding to a given ambient pressure.) For most altitude tests, a pressure altitude of 200,000 ft or less will meet all major test needs. But during development tests of high-performance engines whose thrust chambers are ablatively cooled, extensive tests must be made at pressure altitudes of 350,000–400,000 ft to determine behavior of the chamber materials during orbital coasts. Test objectives also determine whether other environmental factors are to be simulated as well. The list may include such factors as background temperature, solar heat flux, vibration, and acceleration. Rocket test cells that can meet the above conditions are already in operation. They include:

1. Those cells at the Rocket Test Facility, Arnold Engineering Development Center, which can maintain a vacuum through the start, run, and shutdown cycles over a range of rocket sizes up to 500,000 lb thrust. Pressure levels corresponding to ultra-high altitudes up to 400,000 ft can be obtained in their facilities.
2. The eight altitude test stands that have been used by Aerojet-General to test liquid rocket engine assemblies up to 250,000 lb thrust and solid rocket engines up to 80,000 lb thrust.

650894 (JL65-10-73) **Disc Brakes On U.S. Passenger Cars . . . A Status Report.** C. E. Burke, American Motors Corp.; E. E. Prather, Bendix Corp., Bendix Prod. Auto. Div.; F. E. Lueck, Ford Motor Co.; A. R. Brown, and Z. Arkus-Duntov, Chevrolet Motor Div., GMC; and A. R. Shaw, Delco-Moraine Div., GMC. The few disc brake systems available on American production passenger cars are widely divergent in system concept, although disc and caliper designs have many similar features. The problem of front-to-rear brake load distribution is approached differently by each manufacturer, as is that of parking brake design.

650895 (JL65-10-77) **Aerial Recovery Systems Make Flying Catch.** F. M. Highley, Jr., All Amer. Engrg. Co. Objects weighing over 3000 lb can be successfully retrieved in an air-to-air pickup – up to 1600 lb can be snatched from the ground

in a surface-to-air recovery. These, and potential pickups in the realm of 12,000 lb, are made possible by highly developed recovery systems installed in rear loading cargo aircraft.

650896 (JL65-10-80) **Volvo's Versatile, Automated Engine Laboratory.** A. Larborn, Volvo AB. By using a high level of automation, Volvo has gained great efficiency and reliability in its engine development laboratory for the testing of engines ranging from a high-speed 1.8-liter gasoline engine to diesels of 4.7–9.6-liter capacity. The laboratory contains eight function and ten endurance beds. All plumbing and auxiliary equipment is arranged in ventilated pipe alleys in the basement just beneath the test beds, so that the installation can be kept clean, with easy access to engines.

650897 (JL65-10-84) **Foam Plastic Patterns Alleviate Casting Problems.** H. F. Shroyer, Inventor. Foam plastic patterns, a relative newcomer, can alleviate casting difficulties and cut costs as engineers become increasingly aware of the practicality of their potentials. The advantages of foam plastic far outweigh its few limitations in the design of patterns for prototypes and small-run or high-production castings. (Foam plastic patterns are less adaptable to medium-run casting quantities.) Used as a casting pattern, the foam plastic reduces pattern core box costs to a minimum when one-piece parts are required. Machining characteristics of foam-plastic-pattern castings are superior to those made by conventional methods.

650898 (JL65-10-86) **Flight-Test And Research Shed New Light On Jet V/STOL Problems.** M. O. McKinney, Jr., R. E. Kuhn, and J. P. Reeder, Langley Res. Center, NASA. Jet V/STOL operation, particularly in the transition from hover to conventional forward flight, poses design and operating problems peculiar to this type aircraft. Research in the following three major areas is providing new information on these problems:

- Jet induced effects on aerodynamics and stability and control.
- Propulsion aerodynamics in hovering and low-speed flight ranges.
- Flight-test experience on flying qualities of jet V/STOL aircraft.

650899 (JL65-10-92) **New Ford High-Performance Engine Has Single Overhead Camshaft.** N. W. Faustyn and J. Eastman, Ford Motor Co., Eng. & Fdy. Div. To get an engine with higher rpm and better airflow than was possible with a push-rod engine, Ford has designed a conversion-type overhead-camshaft package around its basic production, 427-cu in. push-rod engine. The new 427 single-overhead-camshaft engine is an outgrowth of two high-performance engines – the 427 push-rod and the 255-cu in., dual-overhead-camshaft, "Indianapolis" engine. It uses proved hardware wherever possible to reduce cost, development time, and tooling time.

650900 (JL65-10-94) **Aircraft Arrester Teams With Rear Loading Aircraft For Pinpoint Cargo Delivery.** R. V. Parker, All Amer. Engrg. Co. Military cargo loads up to 30,000 lb can be extracted in one swoop from an airplane flying only 5–7 ft above the ground – for direct delivery to battle line troops below. The system that makes this possible consists of:

- A portable ground arrester that can be transported by units in the field and installed by a small team of men.
- Extraction equipment installed in a rear loading aircraft.

650901 (JL65-11-34) **1966 Passenger-Car Engineering Trends.** W. G. Patton, SAE Journal. 1966 cars probably include a better-than-average number of significant engineering innovations and changes. Here is a list of a few of them:

- The first front-wheel-drive car to be mass-produced in this country since the Cord – the Oldsmobile Toronado.
- A variable ratio steering system – on Cadillac.
- Automatic transmissions that can also be operated manually.
- Higher compression ratio engines on the larger cars – which has been at least partly responsible for the continuing climb in the weighted average compression ratio.
- A "stub" frame in the front and unitized construction in the rear of the Oldsmobile Toronado. Apart from this, there were no switches between unitized and body-and-frame construction.
- Automatic transmissions are smoother shifting and give more effective downhill braking.
- Adhesive mountings are replacing rubber on windshields and backlights.
- Noise and vibration levels have been reduced on most cars.
- New stereo radios, including a radio that operates from tape or by picking up radio station broadcasts; steering wheels with multiple adjustments; new speed control systems; and automatic warning light systems are among the accessories being offered.

650902 (JL65-11-58) **Triple Dual Wheels For Lockheed SST Landing Gears.** K. S. Carter, Lockheed-California Co. For the Model L-2000 supersonic transport, Lockheed engineers are using triple dual wheels for each main landing gear. They chose the design because it appeared the most reasonable arrangement to comply with requirements for tire pressure, moderate pavement loading, and low frontal area. It was chosen also because:

1. Its low frontal area results in less resistance to motion through slush, snow, and water on the runway.
2. It is compatible with pavements actually in use: no pavement reinforcing will be necessary.
3. Its long wheelbase brings no serious problems or penalties.

650903 (JL65-11-61) **Eaton Develops Small 200-HP Retarder For Heavy-Duty Trucks.** W. S. Nagel, Eaton Mfg. Co. An absorption capacity of 200 hp was selected for the new Fuller retarder because

it appears to meet the steady-state braking requirements of most heavy-duty trucks. Such trucks are primarily 5-axle units in the 75,000-lb gvw class. A truck of this size descending a 5% grade at 50 mph develops 500 hp. But tire and air friction, engine braking, and driveline losses absorb 300 hp, leaving only 200 hp for the retarder to absorb.

650904 (JL65-11-62) **Nickel Additive Boosts Engine Performance; Durability.** W. F. Schoen and R. L. Pontious, Sinclair Res., Inc. Test results obtained under both laboratory controlled conditions and those of actual operation has shown that a new gasoline additive, nickel isodecylorthophosphate, combines the qualities of a combustion-chamber deposit modifier, engine life extender, and surfactant. Among its other advantages, this compound:

- Reduces abnormal ignition phenomena induced by deposits, and thus equilibrium octane requirements.
- Retards engine wear and prolongs exhaust valve life.
- Serves as an effective carburetor deicer and rust inhibitor.

650905 (JL65-11-66) **Altitude Test Cells Are Hard To Exhaust.** R. E. Smith, Jr. and J. Ferrell, Jr., ARO, Inc. The most difficult problem in the design of altitude test facilities for rocket engines is to handle the exhaust gas adequately. It is frequently solved by using exhaust gas ejector-diffusers and water spray cooling systems to reduce the volume of exhaust gases to a level at which mechanical pumping is feasible. Pumping requirements before and after firings can be met by auxiliary steam- or air-driven ejector in series with the exhaust gas ejector-diffuser.

650906 (JL65-11-70) **Engines On The Make Need To Try Their Wings.** M. J. Saunders, United Aircraft of Canada Ltd. No amount of foresight or in-house testing will ever completely duplicate actual operating conditions. The flight experience with the PT6, a turboprop-turboshaft engine designed specifically for light engine application, testifies to this. Between the first flight in July 1961 and the first production delivery in December 1963, prototype PT6's were operated in 10 different installations. Of these, four were helicopters, four were fixed-wing, and two were marine. Each of these installations revealed minor problem areas leading to further development test work, and improvements to the production engine, as specific instances will show.

650907 (JL65-11-72) **Value Engineering Cuts VTOL Costs.** D. M. Plumb, United Aircraft Corp., Sikorsky Aircraft Div. Value engineering, as applied to VTOL aircraft, is producing rewarding results in cost reduction. This comparatively new technique employs a creative approach to uncover hidden, unnecessary costs. Applied throughout all phases of a project, value analysis studies product functions, determines their necessity and investigates all alternate approaches to meet the functions at reduced costs.

650908 (JL65-11-75) **Numerically Controlled Machines Aid Product Styling.** R. C. Bevis, Cincinnati Milling & Grinding Mach., Inc.; and E. F. Schloss, Cincinnati Milling Mach. Co. Drilling, milling, and boring machines, known today as essentially individual tools with single-purpose capabilities, will be replaced in the future by numerically controlled machines so broadly based as to conceal their particular identity. These new machines will be used in mass production, particularly by the automotive industry to develop new sets of automotive sheet metal components. Here, one of the main problems is the production of the templates and wooden models that precede actual die construction. In this area, numerical control can improve quality and reduce the tremendously long lead times. The net effect will be to greatly accelerate the styling of new models.

650909 (JL65-11-78) **For Passenger Cars Diesels Must Be Better.** C. J. Walder, Ricardo & Co. Engrs. /1927/ Ltd. If diesels are ever to compete with gasoline engines for passenger cars, they must be capable of better performance, and at the same time they must be quieter and lighter.

650910 (JL65-11-83) **Instantor Brake Eliminates Need For Power Assist.** N. R. Brownyer, Rockwell-Standard Corp. The Instantor brake has been developed to eliminate the need for power assist on vehicles equipped with 4-wheel hydraulic brakes. Tests with various hydraulic systems over a period of years shows the new brake to have the following advantages:

1. Enhanced safety because low pedal effort and short pedal travel are independent of the engine staying alive to provide power.
2. Lower cost than vacuum power systems and lower maintenance cost.
3. Washes out bad effects of mating drum brakes on rear with disc brakes on front. Many random differences in behavior between front and rear brakes in a 4-drum system are mitigated.
4. Use of dual master cylinders to split the rear system makes for extreme safety.
5. Saves under-hood space required for power brake unit of conventional brakes.

650911 (JL65-11-86) **Busted! The Bottleneck Of Air Cargo Handling.** S. R. Wallace, United Air Lines, Inc. United Air Lines has developed a palletized cargo handling system which accelerates the loading and unloading of freight to minimize ground time of its 600-mph, DC-8F jet freighters. Ground time has been cut from the 10 hr 4 min required for the bulk handling of 90,000 lb of freight to 44 min for the new palletized system. Thus, the jets can spend more time in the air, the only place where they earn revenue, and the customer gets the service he expects. To determine total speed for freight handling (speed from receipt of freight at origin to delivery at destination), it was necessary to apply a systems

approach to total freight handling beginning with functional specifications for terminal processing of outbound freight at the point of origin.

650912 (JL65-11-90) **Propane Versus Gasoline: Effects On Engine Performance And Economy.** W. E. Adams, Ethyl Corp.; and K. Boldt, Pure Oil Co. Comparative performance and economy tests of lp-gas mixtures and gasoline in three commercial engines gave these results:

- At a given compression ratio, using commercially available vaporizer-regulators and carburetors, the engines developed 3½–5% less power at high speeds on lp-gas than on gasoline.
- Compared to gasoline, the use of lp-gas reduced brake specific fuel consumption up to 12% at low speeds. At high speeds, lp-gas reduced fuel consumption by 0–9%. On a gallon basis, however, the lp-gas engine used more fuel than the gasoline engine because of the lower specific weight of lp-gas.
- Studies in one engine operated at several compression ratios gave a 12% power increase and an 11% cut in bsfc on lp-gas as compression ratio was raised from 7.5 to 11.5. Similar changes were noted using gasoline. Primary reference fuel antiknock requirement rose 13 performance numbers per compression ratio.

650913 (JL65-12-32) **Engineering Education Swings To Serving Needs Of Society.** N. G. Shidle, SAE Journal. Engineering education is hearing society's call for more than one kind of engineer. Both industry and government are requiring product-oriented as well as research engineers. So engineering education is beginning to swing away from overemphasis on science, and is assuming equal responsibility for graduating:

- Engineers to do the design, manufacturing, and experimental jobs to meet today's problems.
- Engineers to do the research and development jobs to identify and work toward solution of tomorrow's problems.

650914 (JL65-12-36) **Bergman Gives New Meaning To Understeer And Oversteer.** W. Bergman, Ford Motor Co. The introduction of transient conditions to vehicle handling behavior has evolved a new theory of passenger car understeer and oversteer. This new theory:

- Defines understeer-oversteer for various types of inputs.
- States the relationship between understeer-oversteer and directional and oscillatory stability.
- Analyzes the basic sources of understeer-oversteer.
- Enables quantitative determination of vehicle understeer-oversteer caused by individual design factors and steering and/or disturbance inputs.

650915 (JL65-12-52) **Are Sweptwing Jets Upset-Prone?** J. F. Rudolph and R. S. Sliff, Federal Aviation Agency. Aircraft upset or loss of control is now new to aviation; however, in the sweptwing jet it is more serious because the excursions in air-speed and altitude are considerably greater.

There have been several serious cases of upsets and three fatal crashes in which turbulence was suspect but unproved. Not all the reasons for sweptwing jet upsets are known; however, after considerable operational research flight tests in turbulence, and intensive studies by airlines, manufacturers, NASA, and the FAA, it appears that the explanation lies in not one but several suspect areas. They are: the pilot, altitude of the plane, turbulence penetration speed, trim and thrust, fly attitude of the plane, and the use of the autopilot.

650916 (JL65-12-54) **Exotic Alloys – Machining Headaches.** M. Field and W. P. Koster, Metcut Res. Associates, Inc. The same physical properties which make exotic alloys so valuable as aerospace materials also make them the most difficult to machine. Specialized methods, taking advantage of unorthodox techniques, can do things far beyond the limits of conventional machining. Some of these recently developed techniques along with typical applications and performance characteristics, are indexed in the article.

650917 (JL65-12-56) **Wedge Brakes Offer Increased Service Life And Safety.** J. W. Kourik, Wagner Elec. Corp. Wedge brakes, substituting wedge-actuated pistons for the conventional S-cam, offer advantages in weight, and drum life. Demands on the air system are less. Brake designs are readily adaptable to spring set actuators for emergency braking. They are also adaptable for use in split braking systems.

650918 (JL65-12-60) **Gas Turbines Evaluated For Emergency Vehicle Use.** L. H. Williams and K. W. Porter, Boeing Co., Turbine Div.; R. W. French, Sterling Precision Corp., Amer. LaFrance Auto. Div.; and A. M. Flaherty, San Francisco City Shops. The gas turbine for fire department and other emergency-vehicle use is rapidly advancing in its development process. Eventual widespread use in such vehicles may become a reality. This opinion is shared by a fire-department user of gas-turbine equipment and a fire equipment manufacturer in whose vehicle gas turbines have been tested extensively. The engine producer who first powered a truck with a gas turbine more than 15 years ago feels that "it appears reasonable to expect a steady increase in use of gas-turbine-powered emergency vehicles as the demand for more horsepower continues."

650919 (JL65-12-62) **Spotting The Chemical Culprits In Smog Formation.** J. D. Caplan, General Motors Res. Labs. Studies of photochemical smog formation have brought to light three facts which provide a foundation for the rational control of vehicle emissions:

- Smog can always be reduced by decreasing atmospheric concentrations of reactive hydrocarbons.
- Smog can increase as atmospheric concentrations of nitrous oxide are decreased.
- Hydrocarbons vary widely in their tendency to react to form photochemical smog.

650920 (JL65-12-66) **Heeding Thermal Stresses Vital In Liquid Hydrogen Tank Design.** J. Sagata, Douglas Aircraft Co., Inc. Liquid hydrogen creates structural problems in space vehicle propulsion system design, due to its extremely low temperature (–423 F). Temperature gradients of over 500 deg can exist across tank walls or adjacent walls of liquid oxygen tanks, resulting in high thermal stresses and induced buckling loads. Control of the problem becomes difficult when tank insulation itself creates a high temperature gradient.

650921 (JL65-12-68) **Early Operational Difficulties With APU Components Of X-15 Have Been Cured.** J. E. Love, NASA, Flight Res. Center. On the whole, the components of the auxiliary power units on the X-15 manned research plane have given good service. But there have been two periods of difficulty – in very early flights, the pressure-vessel regulator did not operate properly, and later, turbine shaft pinion gear failures were encountered. In both cases, the problems were solved, and the auxiliary power unit is now operating satisfactorily.

650922 (JL65-12-70) **Pneumatic Tire Hydroplaning Can Be Controlled.** W. B. Horne and U. T. Joyner, Langley Res. Center, NASA. Pneumatic tire hydroplaning – or the loss of traction during operation on wet pavements – can be alleviated by proper tire tread design and pavement surface treatment when the pavement is wet or slightly flooded. When pavements are deeply flooded, however, the best tire tread design and the best pavement surface treatment cannot prevent hydroplaning at the critical speed. The use of air jets to remove the fluid from the pavement in front of the tire is a promising means of reducing hydroplaning under this condition.

650923 (JL65-12-75) **Convair Charger – New Aircraft With New Capabilities.** E. E. Patrick, General Dynamics/Convair. The Convair (Model 48) Charger, a twin-turboprop, high-tailed aircraft, was designed specifically to bridge the performance gap between helicopters and high-performance jets. To meet all specifications of the Marines Light Armed Reconnaissance Aircraft the design embodies six major features: (1) Simplicity; (2) Large, low-pressure tires; (3) A 500-ft STOL; (4) Compatibility with existing avionics; (5) Organic air support, either by Charger aircraft or helicopters operating in the squadron; and (6) Use of infantry ordnance and supporting equipment, where possible.

650924 (JL65-12-78) **Pros And Cons Of Acquiring New Aircraft By Leasing.** J. P. Mitchell, Chase Manhattan Bank. Leasing, as a method of acquiring new equipment, is one important way by which some airlines are seeking to benefit from the improved investment tax credit allowances made available in revisions of the 1964 Revenue Act. There is a continuing opportunity to benefit from these allowances, with substantial purchase commitments running into 1968 and 1969.

650925 (JL65-12-80) **New Lab Methods Give Hot Line On Cold Cranking Of Multigrade Oils.** G. K. Vick and G. D. Staffin, Esso Res. & Engrg. Co.; W. A. P. Meyer, R. M. Stewart, and W. D. Lion, Gulf Res. & Dev. Co.; C. J. Prizer and H. R. Stringer, Rohm & Haas Co.; and T. W. Selby, Dow Chemical Co. Laboratory viscometry can now predict cold-starting effects of multigrade oils with polymeric V.I. improvers. Three new methods, each using a different instrument and procedure, come closest to matching the accuracy of the CRC engine cranking test technique (L-49-663). Highly valued because their accuracy corrects the tendency of the SAE Viscosity Classification System to grade such oils wrongly when cold, these methods are based on high-shear measurements taken with: the Ferranti-Shirley coneplate viscometer; the forced-ball viscometer (corrected for gel viscosity); and a simplified reciprocating viscometer.

650926 (JL65-12-84) **Teamwork Pays Off In Truck MPG.** O. J. Blomquist, White Motor Co. Far from just "happening," good gasoline mileage in trucks is still the result of three-way efforts, effectively combined. Vehicle manufacturers, gasoline producers, and fleet operators must all work together for best overall economy. Their respective specialties are: efficiency-oriented design features; energy-packed fuels for maximum power; and preventive maintenance to minimize losses.

650927 (JL65-12-87) **Tires Limited In Skid Prevention.** J. H. Cox, Firestone Tire & Rubber Co. Study of traction on wet pavement discloses the road surface to be far more important than any design or compound of tires. The major tire factors influencing the sliding coefficient of friction are the footprint pressure and the effectiveness of the tread design in expelling and breaking through the water or other lubricating film to restore intimate contact with the pavement.

650928 (JL65-12-88) **Controlling Road Noise In A Tray Frame Car.** M. Shimizu, Prince Motors, Ltd. Road noise level in the latest model of the Japanese Prince sedan was reduced to a satisfactory level by several techniques which culminated in modification of the prototype without sacrificing the roominess, rigidity, and ease of maintenance inherent in its side-member type of tray frame.

650929 (JL65-12-90) **C-5A Cargo Transport To Dwarf Existing Aircraft.** R. S. Martin, Air Force Dept. In addition to being the largest aircraft ever built, the C-5A cargo transport, now in the project definition phase, will establish many other "firsts." Among these are:

1. Designed around loads to carry.
2. Engine designed specifically for cargo aircraft.
3. Procurement on "total package" concept.
4. Cost effectiveness made paramount goal.

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PUBLISHED BY THE SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
485 LEXINGTON AVE., N. Y., N. Y. 10017